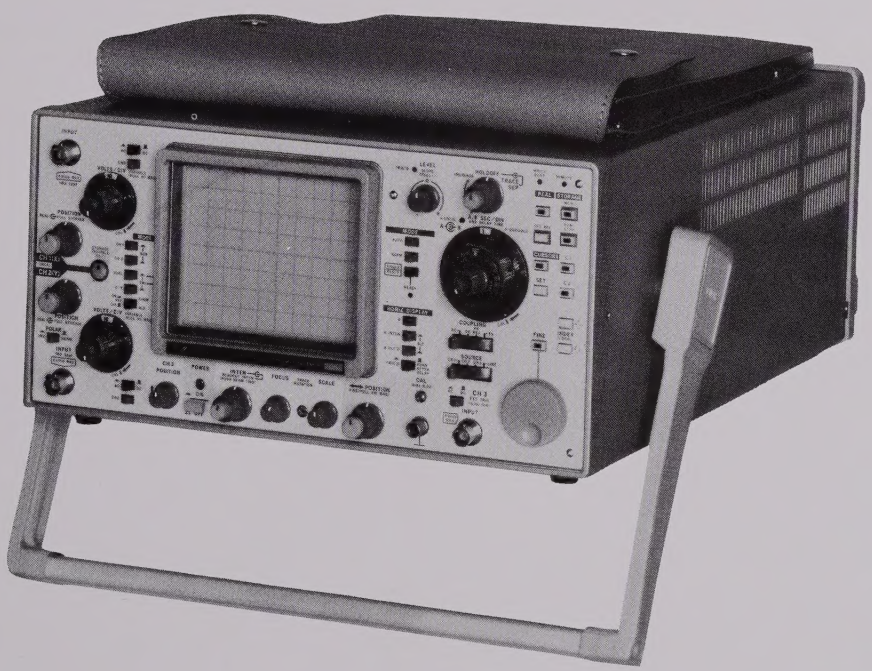
Digital Storage Oscilloscope

DS-6612/DS-6411

SERVICE MANUAL



IWATSU ELECTRIC CO., LTD.

SERVICE MANUAL

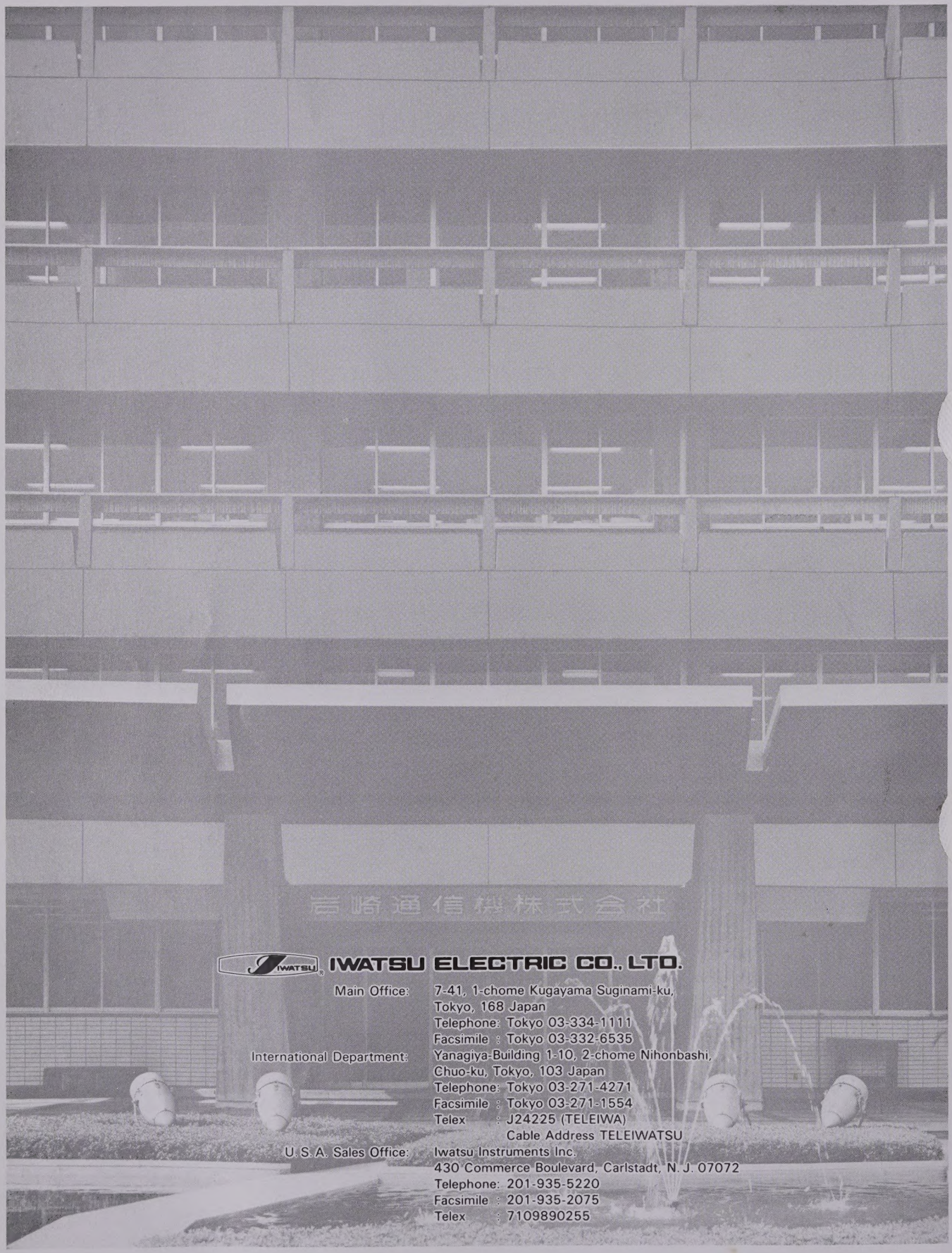
Digital Storage Oscilloscope

DS-6612/DS-6411

IWATSU ELECTRIC CO., LTD.

ASAHISEIMEI BUILDING, 1-3, NIHONBASHI 2-CHOME, CHUO-KU, TOKYO, 103 JAPAN
TEL.: TOKYO (272) 0461 CABLE ADDRESS: TELEPHIWATSU TELEX: J24225 TELEIWA FAX: TOKYO (271) 1554

A1-012500(L)



IWATSU ELECTRIC CO., LTD.

Main Office: 7-41, 1-chome Kugayama Suginami-ku,
Tokyo, 168 Japan
Telephone: Tokyo 03-334-1111
Facsimile : Tokyo 03-332-6535

International Department: Yanagiya-Building 1-10, 2-chome Nihonbashi,
Chuo-ku, Tokyo, 103 Japan
Telephone: Tokyo 03-271-4271
Facsimile : Tokyo 03-271-1554
Telex : J24225 (TELEIWA)
Cable Address TELEIWATSU

U.S.A. Sales Office: Iwatsu Instruments Inc.
430 Commerce Boulevard, Carlstadt, N.J. 07072
Telephone: 201-935-5220
Facsimile : 201-935-2075
Telex : 7109890255

TABLE OF CONTENTS

Section 1	**Specifications**	1-1
1-1	GENERAL	1-1
1-2	ELECTRICAL SPECIFICATIONS	1-1
1-2-1	Vertical Deflection System	1-1
1-2-2	Triggering	1-3
1-2-3	Horizontal Deflection System	1-4
1-2-3-1	STORAGE OFF (REAL)	1-4
1-2-3-2	STORAGE ON	1-5
1-2-4	X-Y Operation	1-5
1-2-4-1	STORAGE OFF (REAL)	1-5
1-2-4-2	STORAGE ON	1-5
1-2-5	Z-axis	1-5
1-2-6	CRT Readouts and Cursor Measurements	1-6
1-2-7	Digital Storage	1-6
1-2-8	Signal Output	1-7
1-2-9	Power Supply	1-7
1-3	DIMENSIONS AND WEIGHT	1-8
1-4	ENVIRONMENTAL CHARACTERISTICS	1-8
1-5	ACCESSORIES	1-9
Section 2	**Circuit Description**	2-1
2-1	GENERAL DESCRIPTION	2-1
2-2	VERTICAL DEFLECTION SYSTEM	2-3
2-2-1	Signal Input and A Attenuator [2]	2-3
2-2-2	CH1 PRE [3] CH2 PRE [4]	2-4
2-2-3	V. CONT [5]	2-5
2-2-4	A/D BUFF [6]	2-8
2-2-5	V-Main Amplifer [7]	2-8
2-2-6	Sync. Signal Generator (TRIGGER GENERATOR) [8]	2-9
2-2-7	A SWEEP G. [9]	2-10
2-2-8	A TIMING CIRCUIT [10]	2-12
2-2-9	B SWEEP G. [11] and B TIMING Circuit [12]	2-12
2-2-10	H-CONT [13]	2-14
2-2-11	H-AMP [14]	2-16
2-2-12	Z-AMP [15]	1-18
2-2-13	HV & CRT [16]	2-20
2-2-14	POWER [17]	2-20
2-2-15	POS [18]	2-20
2-2-16	VR [19]	2-20
2-2-17	V I/O [20] , H I/O [21]	2-21
2-2-18	CPU and Memory [51]	2-22
2-2-19	Reference Clock [51]	2-22
2-2-20	Reset Circuit [51]	2-22
2-2-21	8OH Data Buffer [51]	2-24
2-2-22	DMA Controller [51]	2-25
2-2-23	Status Latch Circuit and LED Lighting [52]	2-26
2-2-24	Interrupt Circuit [52]	2-26
2-2-25	*INT DMKEY (DM Key Processor) [53]	2-27
2-2-26	*INT SSKEY (SS Key Process) 53 ([20] , [21])	2-27
2-2-27	Rotary Encoder Circuit Counter [53]	2-31
2-2-28	Rotary Encoder Circuit Interrupt Controller [52]	2-32
2-2-29	SINGLE RESET KEY Pressed Detector [53]	2-32
2-2-30	SINGLE RESET PULSE, Generator [54]	2-32
2-2-31	GP-IB, RS-232C Parameter Setting [54]	2-32
2-2-32	GP-IB DMA Data Transfer Circuit [54]	2-33
2-2-33	Model Selection on Software [53]	2-34
2-2-34	Others [54]	2-34
2-2-35	GP-IB [58]	2-34
2-2-36	A/D [35]	2-35
2-2-37	A/D [36]	2-38
2-2-38	DM Controller [41] (Digital Memory)	2-40

2-2-39 Description of DM-LSI Terminals 2-50
2-2-40 Display Controller 2-52
2-2-41 CPU Interface [30] 2-54
2-2-42 Waveform Display Circuit [30] 2-54
2-2-43 Character Cursor Generator [31] 2-54
2-2-44 Output D/A Converter [33] 2-54
2-2-45 CDP Block [31] 2-58
2-2-46 Counter Circuit Block [30] . . 2-59
2-2-47 Output Latch Block [30] 2-59
2-2-48 A INTEN Control Circuit Block [31] 2-60
2-2-49 Brightness RAM Circuit [30] 2-60
2-2-50 Output D/A Circuit [33] 2-60

Section 3 Maintenance 3-1
3-1 PREVENTIVE MAINTENANCE . . 3-1
3-1-1 Cleaning 3-1
3-1-2 If Unused for a Long Time 3-1
3-1-3 Checking 3-2
3-1-4 Periodic Adjustment 3-2
3-1-5 Maintenance Aids 3-3
3-2 REMOVAL AND REPLACEMENT INSTRUCTIONS 3-4
3-2-1 Cover Removal 3-4
3-2-2 Printed Circuit Board Removal . 3-6
3-2-3 Printed Circuit Board Parts Replacement 3-9
3-2-4 Replacing Resistors, Diodes or ICs 3-9
3-2-5 High-Voltage Power Transformer Replacement 3-9
3-2-6 CRT Replacement 3-10
3-3 TROUBLESHOOTING 3-12
3-3-1 Troubleshooting Reference 3-12
3-3-2 Instruments Required for Troubleshooting 3-12
3-3-3 Troubleshooting Steps 3-12

Section 4 Check and Adjustment 4-1
4-1 GENERAL 4-1
4-2 PERIOD OF CHECK AND ADJUSTMENT 4-1
4-3 PRECAUTIONS FOR CHECK AND ADJUSTMENT 4-1
4-4 EQUIPMENT REQUIRED 4-2
4-5 CHECK AND ADJUSTMENT ITEMS 4-4
4-6 PREPARATION 4-5
4-6-1 Before Making Check and Adjustment, Prepare 4-5
4-6-2 Printed Circuit Board Locations 4-5
4-6-3 Check-points and Adjuster Locations 4-5
4-7 POWER SUPPLY • CRT • CALIBRATOR OUTPUT 4-11
4-7 POWER SUPPLY • CRT and Calibrator Output 4-12
4-7-1 Power Supply 4-12
4-7-2 AC Voltage Range 4-13
4-7-3 CRT Cathode Voltage 4-14
4-7-4 Intensity 4-15
4-7-5 Focus 4-16
4-7-6 The Parallel of the Horizontal Trace and the Horizontal Scale (TRACE ROTATION) 4-17
4-7-7 Pattern Distortion 4-18
4-7-8 Calibrator Output Voltage 4-19
4-7-9 Calibrator Output Repetition Rate 4-19
4-8 VERTICAL DEFLECTION SYSTEM 4-20
4-8 VERTICAL DEFLECTION SYSTEM (Cont.) 4-21
4-8-1 X5 Balance and Variable Balance 4-21
4-8-2 GAIN 4-22
4-8-2 GAIN (Cont.) 4-23
4-8-3 Attenuator Compensation 4-24
4-8-3 Attenuator Compensation (Cont.) 4-25
4-8-4 Square Wave Characteristics . . . 4-26
4-8-4 Square Wave Characteristics (Cont.) 4-27
4-8-5 Bandwidth 4-28

4-8-6	Linearity	4-29
4-9	TRIGGERING	4-30
4-9	TRIGGERING (Cont.)	4-31
4-9-1	A Trigger	4-31
4-9-1	A Trigger (Cont.)	4-32
4-10	HORIZONTAL DEFLECTION SYSTEMS	4-33
4-10	HORIZONTAL DEFLECTION SYSTEMS (Cont.)	4-34
4-10-1	Magnifier Center	4-34
4-10-2	A Sweep Time Accuracy	4-35
4-10-3	X10 A Sweep Time	4-36
4-10-4	A Sweep Length	4-37
4-10-5	A, B Sweep Start Point	4-38
4-10-6	B Sweep Start and Stop	4-39
4-10-7	X-Y Gain • Position	4-40
4-11	CURSOR • A/D CONVERTER SYSTEM	4-41
4-11-1	Horizontal Cursor	4-42
4-11-2	VERTICAL CURSOR	4-43
4-11-3	Stable of Characteristics	4-44
4-11-4	A/D Converter OFFSET • GAIN Position	4-45
4-11-5	Square Wave Characteristics in STORAGE Mode (Overshoot and Other Distortions)	4-46
4-11-6	Frequency Band Width	4-47
4-11-7	Equivalent Sampling Start and Stop	4-48
4-11-8	Storage X10	4-49
Section 5	**Block Diagrams**	5-1
Section 6	**Electrical Parts List**	6-1

MEMO

Section 1 Specifications

1-1 GENERAL

This manual provides the information on specifications check and calibration for the DS-6612/DS-6411.

Before specifications check and calibration, read the "Electrical Specifications" column thoroughly first. Then, prepare each measuring instrument, referring to "Required Measuring Instruments" in the "Performance Inspection and Calibration" column.

When you proceed with specifications check and calibration, set a room temperature to a normal temperature (+23°C ±5°C), turn on the power switch of this unit, warm it up for about 30 minutes, and then, start.

During calibration, read "Specifications Check and Calibration" fully and be careful not to touch a high-voltage power circuit, etc.

1-2 ELECTRICAL SPECIFICATIONS

1-2-1 Vertical Deflection System

Item	DS-6612	DS-6411
Mode	STORAGE OFF (REAL) CH1, CH2, ADD, DUAL/TRI (ALT, CHOP), X-Y CHOP switching frequence: Approx. 130 kHz STORAGE ON CH1, CH2, DUAL, REF (ON/OFF)	STORAGE OFF (REAL) CH1, CH2, ADD, DUAL/TRI (ALT, CHOP), X-Y CHOP switching frequence: Approx. 130 kHz STORAGE ON CH1, CH2, DUAL, REF (ON/OFF)
Channels 1 and 2 Deflection factor	5 mV/div to 10 V/div 1-2-5 sequence of 11 steps Accuracy: ±2% (10°C to 35°C) 5 mV/div to 25 V/div Continuously variable with a fine regulator 1 mV/div to 2 mV/div (x 5 MAG ON) Accuracy: ±4% (10°C to 35°C)	5 mV/div to 10 V/div 1-2-5 sequence of 11 steps Accuracy: ±2% (10°C to 35°C) 5 mV/div to 25 V/div Continuously variable with a fine regulator 1 mV/div to 2 mV/div (x 5 MAG ON) Accuracy: ±4% (10°C to 35°C)
Frequency band width	5 mV/div to 0.2 V/div: DC to 60 MHz –3dB (10°C to 35°C) 1 mV/div, 2 mV/div (x 5 MAG ON) DC to 20 MHz –3dB (10°C to 35°C) [Note] Lower limit frequency for AC coupling: 4 Hz	5 mV/div to 0.2 V/div: DC to 40 MHz –3dB (10°C to 35°C) 1 mV/div, 2 mV/div (x 5 MAG ON) DC to 20 MHz –3dB (10°C to 35°C) [Note] Lower limit frequency for AC coupling: 4 Hz

Item	DS-6612	DS-6411
Rise time	Approx. 5.8 ns (calculated) Rise time calculated from bandwidth x rise time = 0.35	Approx. 8.8 ns (calculated) Rise time calculated from bandwidth x rise time = 0.35
Square wave characteristics	At 5 mV/div Overshoot: 7% (10°C to 35°C) Sag (at 1 kHz): 2% (10°C to 35°C) Other distortions: 5% (10°C to 35°C)	At 5 mV/div Overshoot: 7% (10°C to 35°C) Sag (at 1 kHz): 2% (10°C to 35°C) Other distortions: 5% (10°C to 35°C)
Signal delay	With delay cable	With delay cable
Input coupling	AC, DC, GND	AC, DC, GND
Input RC	Direct: 1MΩ ± 2% // 32pF ± 3pF With probe: 10MΩ ± 2% // 21pF ± 3pF	Direct: 1MΩ ± 2% // 32pF ± 3pF With probe: 10MΩ ± 2% // 21pF ± 3pF
Max. input voltage	Direct: 400V (DC + AC peak) With probe: 600V (DC + AC peak)	Direct: 400V (DC + AC peak) With probe: 600V (DC + AC peak)
Drift	30 min. after power-on (standard values) At 5 mV/div: 0.5 div/hour At 1 mV/div: 2.5 div/hour	30 min. after power-on (standard values) At 5 mV/div: 0.5 div/hour At 1 mV/div: 2.5 div/hour
Common mode rejection ratio	At 5 mV/div 40 : 1 or less (1 kHz sine wave) 15 : 1 or less (5 MHz sine wave)	At 5 mV/div 40 : 1 or less (1 kHz sine wave) 15 : 1 or less (5 MHz sine wave)
Inversion	CH2 only	CH2 only
Channel 3		
Deflection factor	0.1V/div Accuracy: ±3% (10°C to 35°C)	0.1V/div Accuracy: ±3% (10°C to 35°C)
Frequency band width	DC to 60 MHz –3dB (10°C to 35°C) [Note] Lower limit frequency for AC coupling 4 Hz	DC to 40 MHz –3dB (10°C to 35°C) [Note] Lower limit frequency for AC coupling 4 Hz
Square wave characteristics	Overshoot: 10% (10°C to 35°C) Sag (at 1 kHz): 3% (10°C to 35°C) Other distortions: 9% (10°C to 35°C)	Overshoot: 10% (10°C to 35°C) Sag (at 1 kHz): 3% (10°C to 35°C) Other distortions: 9% (10°C to 35°C)
Input coupling	AC, DC	AC, DC
Input RC	Direct: 1MΩ ± 20% // 32pF ± 8pF With probe: 10MΩ ± 2% // 21pF ± 3pF	Direct: 1MΩ ± 20% // 32pF ± 8pF With probe: 10MΩ ± 2% // 21pF ± 3pF
Max. input voltage	Direct: 400V (DC + AC peak) With probe: 600V (DC + AC peak)	Direct: 400V (DC + AC peak) With probe: 600V (DC + AC peak)

1-2-2 Triggering

<table>
<tr><th>Item</th><th>DS-6612</th><th>DS-6411</th></tr>
<tr><td>Source</td><td>CH1, CH2, CH3, LINE
[Note] External triggering is enabled by setting trigger source to CH3.</td><td>CH1, CH2, CH3, LINE
[Note] External triggering is enabled by setting trigger source to CH3.</td></tr>
<tr><td>Coupling</td><td>AC, DC, HF, REJ, TV
(A sweep: TV-V, B sweep: TV-H)</td><td>AC, DC, HF, REJ, TV
(A sweep: TV-V, B sweep: TV-H)</td></tr>
<tr><td>Slope</td><td>+, –</td><td>+, –</td></tr>
<tr><td>Maximum trigger level</td><td>(10°C to 35°C)
<table><tr><th rowspan="2">Frequency Range</th><th colspan="2">Level</th></tr><tr><th>CH1·CH2</th><th>CH3</th></tr><tr><td>DC to 5 MHz</td><td>0.5 div</td><td>1 div</td></tr><tr><td>5 MHz to 60 MHz</td><td>1.5 div</td><td>3 div</td></tr></table></td><td>(10°C to 35°C)
<table><tr><th rowspan="2">Frequency Range</th><th colspan="2">Level</th></tr><tr><th>CH1·CH2</th><th>CH3</th></tr><tr><td>DC to 5 MHz</td><td>0.5 div</td><td>1 div</td></tr><tr><td>5 MHz to 40 MHz</td><td>1.5 div</td><td>3 div</td></tr></table></td></tr>
<tr><td></td><td colspan="2">[Notes]
• Trigger signals are attenuated in the following frequency ranges depending on coupling
AC 100 Hz or less
HF REJ 10 kHz or more
• Auto sweep mode: The lower usable frequency is 50 Hz
• TV-V, TV-H synchronizing signal level: 1 div or more on screen amplitude for a composite video signal composed of 7 parts video signal and 3 parts synchronizing signal.</td></tr>
</table>

1-2-3 Horizontal Deflection System

1-2-3-1 STORAGE OFF (REAL)

Item	DS-6612	DS-6411
Mode	A, A INTEN, ALT, B DLY'D	A, A INTEN, ALT, B DLY'D
A Sweep		
Sweep mode	AUTO, NORM, SINGLE	AUTO, NORM, SINGLE
Sweep time	50 ns/div to 0.5 s/div 1-2-5 sequence of 22 steps 50 ns/div to 1.25 s/div Continuously variable with a fine regulator Accuracy I (over center 8 divisions): ±2% (10°C to 35°C) Accuracy II (over arbitrary 2 divisions within center 8 divisons): 0.2 μs/div to 0.5 s/div ±5% (10°C to 35°C) 50 ns/div, 0.1 μs/div ±7% (10°C to 35°C)	0.1 μs/div to 0.5 s/div 1-2-5 sequence of 21 steps 0.1 μs/div to 1.25 s/div Continuously variable with a fine regulator Accuracy I (over center 8 divisions): ±2% (10°C to 35°C) Accuracy II (over arbitrary 2 divisons within center 8 divisions): 0.2 μs/div to 0.5 s/div ±5% (10°C to 35°C) 0.1 μs/div ±7% (10°C to 35°C)
Holdoff time	Variable with a regulator	Variable with a regulator
B Sweep		
Delay	Continuous delay (RUNS AFTER DELAY), Triggered delay (TRIG'D)	Continuous delay (RUNS AFTER DELAY), Triggered delay (TRIG'D)
Sweep time	50 ns/div to 50 ms/div 1-2-5 sequence of 19 steps Accuracy I (over center 8 divisions): ±2% (10°C to 35° C) Accuracy II (over arbitrary 2 divisons within center 8 divisions): 0.2 μs/div to 50 ms/div ±5% (10°C to 35°C) 50 ns/div, 0.1 μs/div ±7% (10°C to 35°C)	0.1 μs/div to 50 ms/div 1-2-5 sequence of 18 steps Accuracy I (over center 8 divisions): ±2% (10°C to 35°C) Accuracy II (over arbitrary 2 divisions within center 8 divisions): 0.2 μs/div to 50 ms/div ±5% (10°C to 35°C) 0.1 μs/div ±7% (10°C to 35°C)
Delay jitter	1/10,000 or less	1/10,000 or less
Sweep magnification	10 times (max. sweep time: 5ns/div) Accuracy I (over center 8 divisions) 5 ns/div to 50 ms/div: ±5% (10°C to 35°C) [Note] 20 ns from a sweep start point and 40 ns from a sweep end point are excluded. Accuracy II (over arbitrary 2 divisions within center 8 divisions): 20 ns/div to 50 ms/div ±6% (10°C to 35°C) 5 ns/div, 10 ns/div ±10% (10°C to 35°C)	10 times (max. sweep time: 10 ns/div) Accuracy I (over center 8 divisions) 10 ns/div to 50 ms/div: ±5% (10°C to 35°C) [Note] 20 ns from a sweep start point and 40 ns from a sweep end point are excluded. Accuracy II (over arbitrary 2 divisions within center 8 divisions): 20 ns/div to 50 ms/div ±6% (10°C to 35°C) 10 ns/div ±10% (10°C to 35°C)

1-2-3-2 STORAGE ON

Item	DS-6612	DS-6411
Mode	A, A INTEN, B DLY'D	A, A INTEN, B DLY'D
A/B Sweep		
Normal storage	5 μs/div to 0.5 s/div	10 μs/div to 0.5 s/div
Roll mode	0.1 s/div to 500 s/div	0.1 s/div to 500 s/div
Equivalent sampling	50 ns/div to 50μs/div	———
Sweep magnification	Same as in 1-2-4-1	Same as in 1-2-4-1

1-2-4 X-Y Operation

1-2-4-1 STORAGE OFF (REAL)

Item	DS-6612	DS-6411
Input	CH1 for the X axis, CH2 for the Y axis	CH1 for the X axis, CH2 for the Y axis
X axis		
Deflection factor	Same as that of CH1 Accuracy: ±5% (10°C to 35°C)	Same as that of CH1 Accuracy: ±5% (10°C to 35°C)
Frequency band width	DC to 2 MHz –3dB	DC to 2 MHz –3dB
Input RC	Same as that of CH1	Same as that of CH1
Max. input voltage	Same as that of CH1	Same as that of CH1
Y axis	Same as that of CH2	Same as that of CH2
X-Y phase difference	3° or less (DC to 50 kHz)	3° or less (DC to 50 kHz)

1-2-4-2 STORAGE ON

Item	DS-6612	DS-6411
X-Y axis	CH1 for the X axis/CH2 for the Y axis or REF1 for the X axis/REF2 for the Y axis.	CH1 for the X axis/CH2 for the Y axis or REF1 for the X axis/REF2 for the Y axis.

1-2-5 Z-axis

Item	DS-6612	DS-6411
Sensitivity	3 Vp-p	3 Vp-p
Slope	Positive-going signal decreases the brightness.	Positive-going signal decreases the brightness.
Frequency band width	DC to 3 MHz	DC to 3 MHz
Input resistance	10 kΩ±20%	10 kΩ±20%
Max. input voltage	50V (DC + AC peak)	50V (DC + AC peak)

1-2-6 CRT Readouts and Cursor Measurements

Item	DS-6612	DS-6411
Readouts	The following parameters are displayed: CH1 deflection factor, CH2 deflection factor, CH3 deflection factor, REF1 deflection factor, REF2 deflection factor, A and B sweep times, sweep delay time, various modes	The following parameters are displayed: CH1 deflection factor, CH2 deflection factor, CH3 deflection factor, REF1 deflection factor, REF2 deflection factor, A and B sweep times, sweep delay time, various modes
Cursor measurements	STORAGE OFF (REAL) ΔV, Δt, VOLTAGE RATIO, PHASE STORAGE ON ΔV, Δt, VOLTAGE RATIO, PHASE, PEAK TO PEAK, GO/NO GO, GND REFERENCE, MAX & MIN	STORAGE OFF (REAL) ΔV, Δt, VOLTAGE RATIO, PHASE STORAGE ON ΔV, Δt, VOLTAGE RATIO, PHASE, PEAK TO PEAK, GO/NO GO.

1-2-7 Digital Storage

Item	DS-6612	DS-6411
A/D converter	2	2
Resolution	8 bits	8 bits
Max. conversion rate	20 M samples/sec	10 M samples/sec
Data length	1 k word or 16 k words	1 k word or 16 k words
Equivalent sampling	DC to 60 MHz	———
No. of averagings	2, 4, 8, 16, 32, 64, 128 and 256 times	2, 4, 8, 16, 32, 64, 128 and 256 times
Interpolation function	Linear and sine interpolations	Linear and sine interpolations
GO/NO GO judgment	Setting with two vertical cursors and a wide waveform	Setting with two vertical cursors and a wide waveform
Waveform output		
X-Y recorder	Automatically draws scales and waveforms.	Automatically draws scales and waveforms.
Plotter	Recording of scales, waveforms, setting conditions and cursor measured values	Recording of scales, waveforms, setting conditions and cursor measured values
Waveform enlargement		
Vertical	X2/3 to X1.5	X2/3 to X1.5
Horizontal	X1 to X100	X1 to X100
Data position	11 steps (0 to 10 div)	11 steps (0 to 10 div)
EXT CLOCK IN	Level L: 0.6V or less, 40 ns or more H: 2.7V or more, 40 ns more Repeating frequency: 10 MHz or less	Level L: 0.6V or less, 40 ns or more H: 2.7V or more, 40 ns more; Repeating frequency: 10 MHz or less

1-2-8 Signal Output

Item	DS-6612	DS-6411
Calibrator		
Waveform	Square wave	Square wave
Repeatition frequency	1 kHz Accuracy: ±1% (10°C to 35°)	1 kHz Accuracy: ±1% (10°C to 35°C)
Duty ratio	40 : 60	40 : 60
Output voltage	0.3V Accuracy: ±1% (10°C to 35°C)	0.3V Accuracy: ±1% (10°C to 35°C)
PEN X signal output		
Output voltage	Approx. 0.6V per division of displayed signal	Approx. 0.6V per division of displayed signal
Output resistance	1 kΩ±20%	1 kΩ±20%
PEN Y signal output		
Output voltage	Approx. 0.6V per division of displayed signal	Approx. 0.6V per division of displayed signal
Output resistance	1 kΩ±20%	1 kΩ±20%
PEN UP/DOWN output		
Output voltage	Approx. +5V (reference voltage: approx. 0V)	Approx. +5V (reference voltage: approx. 0V)
Output resistance	1 kΩ±20% at 0V 3.2 kΩ±20% at +5V	1 kΩ±20% at 0V 3.2 kΩ±20% at +5V
GO/NO GO output		
Output voltage	Approx. +5V (reference voltage: approx. 0V)	Approx. +5V (reference voltage: approx. 0V)
Output resistance	1 kΩ±20%	1 kΩ±20%

1-2-9 Power Supply

Item	DS-6612	DS-6411
Voltage range	100 (90 to 110)/115 (103 to 128)/220 (195 to 242)/230, 240 (207 to 250)V AC Respective voltage ranges can be selected with an AC input voltage selector (A/B/C/D).	100 (90 to 110)/115 (103 to 128)/220 (195 to 242)/230, 240 (207 to 250) V AC Respective voltage ranges can be selected with an AC input voltage selector (A/B/C/D).
Frequency range	50 to 440 Hz	50 to 440 Hz
Power consumption	Approx. 100W (at 100V AC)	Approx. 80W (at 100V AC)

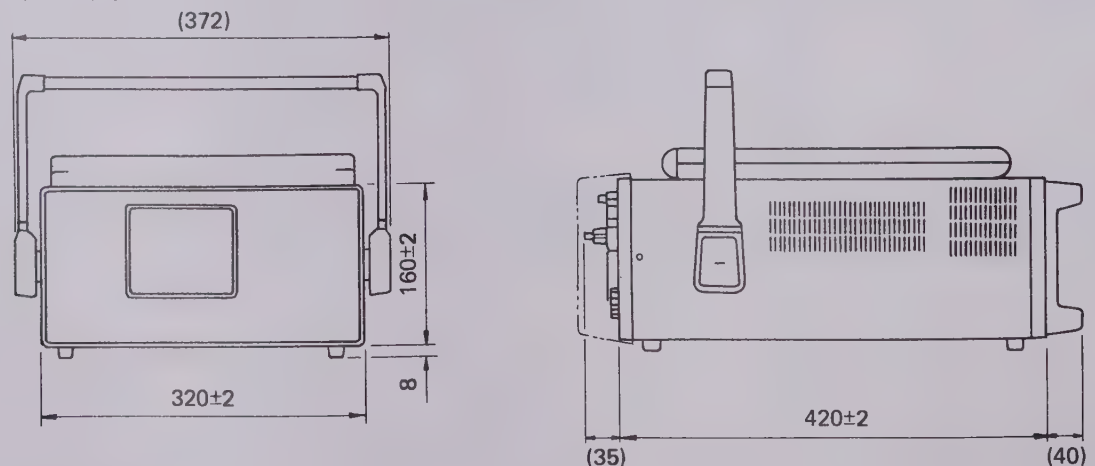
1-3 DIMENSIONS AND WEIGHT

Item	DS-6612	DS-6411
Weight	Approx. 11 kg	Approx. 11 kg
Dimensions	(320±2) W x (160±2) H x (420±2) L(mm)	(320±2) W x (160±2) H x (420±2) L (mm)

1-4 ENVIRONMENTAL CHARACTERISTICS

Item	DS-6612	DS-6411
Temperature		
Operating	0°C to +40°C	0°C to +40°C
Non-operating	–20°C to +70°C	–20°C to +70°C
Humidity		
Operating	Up to 90% relative humidity at 40°C	Up to 90% relative humidity at 40°C
Non-operating	Up to 80% relative humidity at 70°C	Up to 80% relative humidity at 70°C
Altitude		
Operating	5,000 m (atmospheric pressure 405 mmHg)	5,000 m (atmospheric pressure 405 mmHg)
Non-operating	15,000 m (atmospheric pressure 90 mmHg)	15,000 m (atmospheric pressure 90 mmHg)
Vibration	Vibrated in three orthogonal axes for 15 minutes per axis; 0.63 mm peak-to-peak excursion; 10 to 55 Hz. 1 minute/octave sweep.	Vibrated in three orthogonal axes for 15 minutes per axis; 0.63 mm peak-to-peak excursion; 10 to 55 Hz. 1 minute/octave sweep.
Impact	Raise one side 10 cm up (an elevation angle of 30° at maximum) and let it fall on a piece of hard wood. Try this test 3 times for each side.	Raise one side 10 cm up (an elevation angle of 30° at maximum) and let it fall on a piece of hard wood. Try this test 3 times for each side.
Drop	After packing the product for transportation, drop it from a height of 90 cm.	After packing the product for transportation, drop it from a height of 90 cm.

Figure 1-3. Dimensions



1-5 ACCESSORIES

DS-6612		DS-6411	
Power cord	1	Power cord	1
Probe (SS-0011R)	2	Probe (SS-066R)	2
Fuse	2	Fuse	2
Panel cover	1	Panel cover	1
Dust cover	1	Dust cover	1
Accessories bag	1	Accessories bag	1
Instruction manual	1	Instruction manual	1

MEMO

Section 2 Circuit Description

2-1 GENERAL DESCRIPTION

This section describes the operating principles of the DS-6612/DS-6411.

The digital storage oscilloscope DS-6612/DS-6411 is an oscilloscope with an A/D converter added as a waveform storage function. Figure 2-1. Shows its Block Diagram.

- REAL

  Signals from the CH1, CH2, CH3 preamplifiers are selected with the V-control and passed to the CRT through the V-main amplifier after a signal delay of about 100 ns by the delay cable.

  The CH1, Ch2, CH3 signals are selected by the trigger amplifier to generate trigger signals. The sweep generator is started by the trigger signal and outputs a sawtooth wave. The sawtooth wave is led from the H-CONTROL to the H-AMP and supplied to the CRT.

  The Z-AMP (brightness modulating amplifier) receives a gate signal from the sweep generator through the H-CONT. A brightness signal is amplified by the Z-AMP, offset and supplied to the CRT circuit.

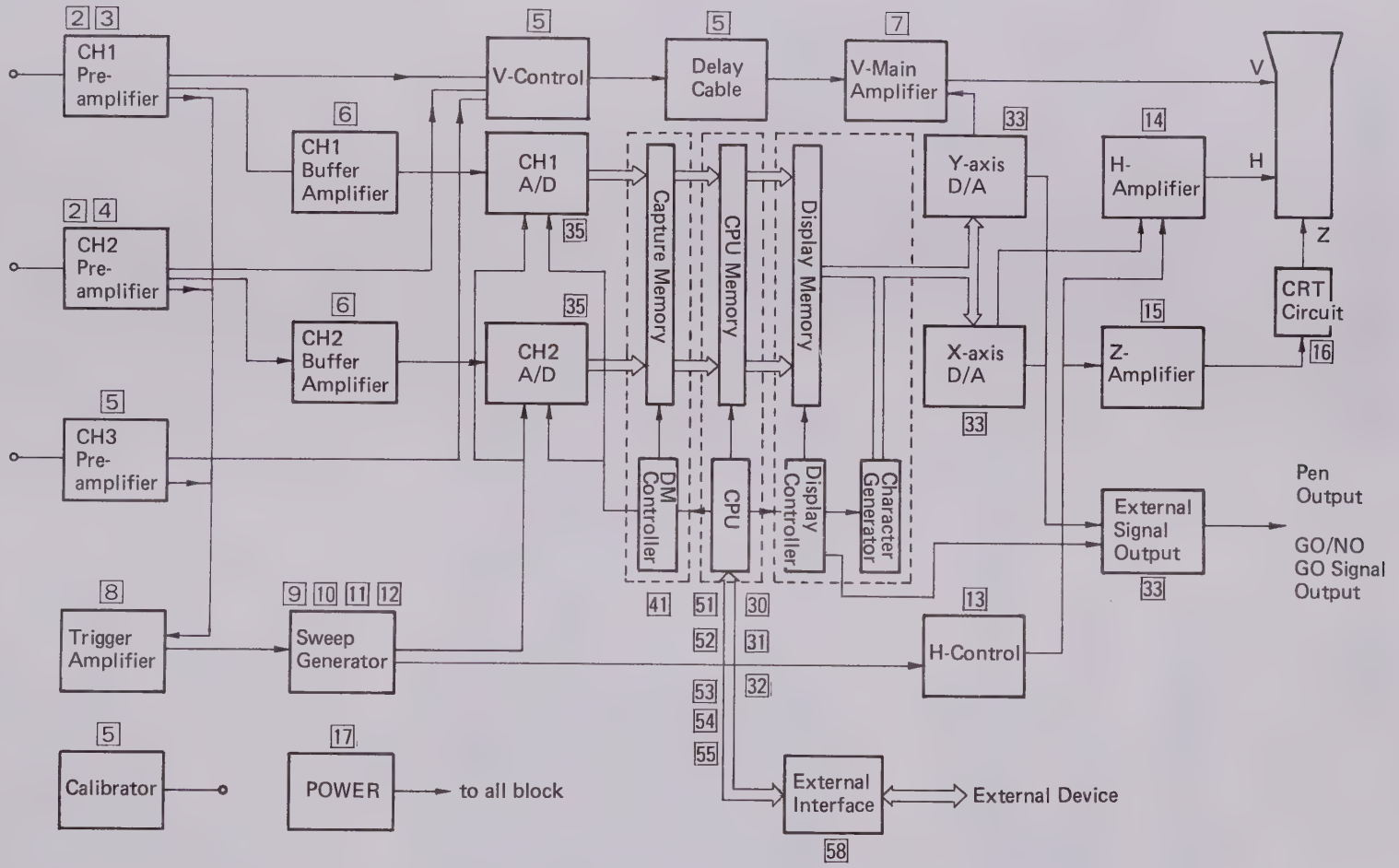
- STORAGE

  Signals, which have passed through the CH1 and CH2 preamplifiers, are input to the buffer amplifiers, respectively. The buffer amplifiers makes constant an input signal DC mean potential. The outputs of the buffer amplifier are led to the A/D circuits through the delay cable of about 100 ns.

  Analog signals inputted to the A/D circuits are A/D-converted and taken into the capture memory by controls provided by the DM controller.

  Waveform data taken into the capture memory is DMA-transferred to the CPU memory by CPU controls and edited there. Edited waveform data is DMA-transferred to the display memory. The display controller controls a display of characters, cursor, symbols and waveform data. These display signals are led to the H-AMP, V-MAIN AMP through the D/A converter, and displayed on the CRT.

Figure 2-1. DS-6612/6411 Block Diagram



2-2 VERTICAL DEFLECTION SYSTEM

2-2-1 Signal Input and Attenuator [2]

Signals measured include very weak signals, high-voltage signals, DC/AC voltage signals, and low-frequency to high-frequency signals in case of an AC voltage. This circuit is intended for adjusting these signals for easy observation. It consists of COUPLINGS and an attenuator.

The COUPLINGS select between DC coupling and AC coupling with the switches S0201 and S0204, and select an input between GND and INPUT with S0202 and S0205. Coupling condensers for AC coupling are C0201 and C0203.

The impedance of the ATTENUATOR is of 1 MΩ system. The attenuation ratios of the ATTENUATOR are 1/1, 1/10, 1/100 and 1/1,000 at the front stage, and 1/1, 1/2 and 1/4 at the rear stage. They are combined to be selected in 11 steps of 1/1, 1/2, . . . , 1/2,000, thus realizing a range selection of 5 mV/div to 10 V/div.

The signal attenuated by the ATTENUATOR is transmitted to RL0401 through R0206 first, and then, through RL0301 and R0236.

The wafer E for S0203 and S0206 are for creating attenuator setting range information codes. This setting range information is serially converted, read by the CPU and used for a range display on the CRT and a conversion of measured data.

2-2-2 CH1 PRE [3] CH2 PRE [4]

This block consists of a 1st-stage amplifier, 2nd-stage amplifier, trigger 1st-stage amplifier, trigger signal selector, trigger 2nd-stage amplifier and X-Y signal amplifier.

A signal from the ATTENUATOR first enters RL0301. This relay is, in cursor measurement in the STORAGE mode, intended for grounding an input when making GND REFERENCE and Max./Min. settings to take in GND data. (not provided for the DS-6411) Next, the signal is terminated in 1 MΩ at R0302, enters the gate of FET Q0301 and converted into a low impedance at Q0301 and Q0302. The 1st-stage amplifier is a differential amplifier and the other input contains Q0303 to balance a temperature with Q0302.

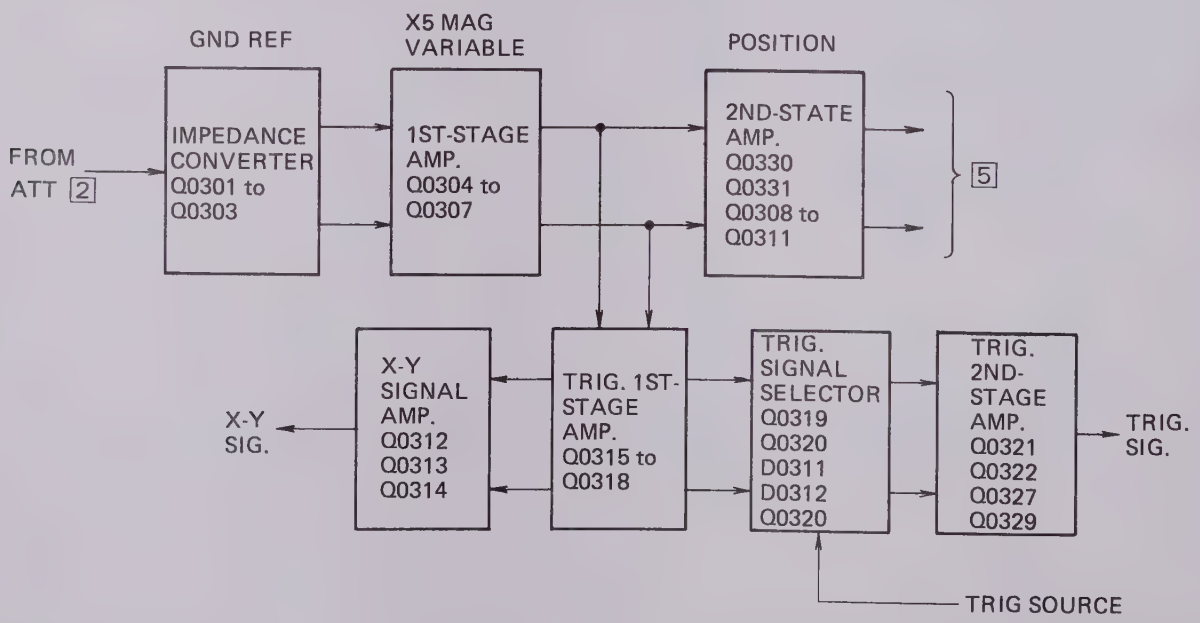
The 1st-stage amplifier is a cascade amplifier. Load resistors are R0377 and R0378, where X5 MAG and VARIABLE founctions are performed. The X5 MAG founction increases an amplifier gain by inserting R0337 in parallel to the emitter resistors R0334 of Q0304 and Q0305, and at the same time, narrows down a frequency band width by inserting C0314 and C0315 between collectors, thus reducing noises. The VARIABLE function is realized by changing a resistance value between the collectors of Q0304 and Q0305. The output of the 1st-stage amplifier enters the 2nd-step amplifier, which consists of Q0308 to Q0311, through the emitter followers of Q0330 and Q0331. This amplifier is also a cascade amplifier. This has a POSITION function and a CH2 POLARITY function. POSITION can be changed by changing a ratio of the current, which flows through the POSITION control knob, to that (signal current), which flows through Q0310 (Q0311).

A signal from the 1st-stage amplifier not only goes to Q0330 and Q0331, but also enters the Q0315 and Q0316 bases through Q0317 and Q0318, respectively.

Signals from the Q0315 and Q0316 emitters are divided into two. One of them is turned into an X-axis signal for single-output X-Y display at Q0313 and Q0314 and supplied to the H-CONT [13] . The other one is inputted to the cascade amplifier of Q0321 and Q0322 through Q0319 and Q0320. Its output is turned into a sync. signal and supplied to the TRIG. G. [8] .

A CH2 sync. signal also enters this cascade amplifier's base grounded emitter. With D0311, D0312, D0411 and D0412, either CH1 or CH2 signal is supplied to the TRIG. G. [8] through the TRIG 2nd-stage amplifier, according to the SOURCE control switch.

Figure 2-2-2. CH1 Preamplifier Block Diagram



2-2-3 V. CONT [5]

The V. CONT has the following circuits:

- Circuit which switches CH1, CH2 and CH3 signals into one and supplies it to the V. main circuit [7] through the DELAY LINE.
- Circuit which supplies CH1 and CH2 signals to the A/D buffer [6] circuit.
- VERT. MODE switch CAL (calibration) circuit, and circuit which generates a CHOP/ALT selector signal with an original CAL signal.
- Circuit which generates a CHOP BLANKING signal.

CH3 PRE AMP

The CH3 PRE AMP is connected to the TRIG. G. [8] . A signal inputted to CH3 passes through the DC/AC coupling circuit, is terminated in 1 MΩ at R0832 and enters the gate of FEF Q0810.

The source output of Q0810 is turned into a TRIGGER SIGNAL through the Q0811 emitter follower, and at the same time, enters the Q0522 base of the V-CONT [5] circuit through the Q0813 emitter follower. The output of the switching circuit is inputted to one side of the differential input of the cascade amplifier which consists of Q0521, Q0522, Q0523, Q0524.

Inputted to the other input Q0521 of this differential amplifier is CH3 POSITION level signal from CH3 POSITION R1918 through the Q0550 emitter follower.

Switching Circuit

This circuit leads CH1, CH2 and CH3 signals to the DELAY LINE DRIVE circuit and A/D BUFF circuit [6] , per the VERT. MODE switch and REAL/STORAGE mode selector switch.

The Q0505 base is 1.5V. Since the Q0513 base is at "H" in the REAL mode, it is turned on, and it is turned OFF when the Q0503 base is at almost 0V. Therefore, when the Q0501 base potential is increased higher than the Q0505 base potential, Q0501 is turned on and Q0505 is turned off, and the CH1 signal is not connected to the DELAY LINE DRIVE circuit.

When the Q0501 base potential is lowered, Q0501 is turned OFF and Q0505 is turned ON, and the CH1 signal is sent to the delay line drive circuit. This switching method determines which channel signal of the respective CH1, CH2 and CH3 differential amplifiers is allowed to pass, with *CH1, *CH2 and *CH3 of J0502 pins 12, 14 and 16.

For the ALT Mode

When the VERT. MODE switch is shifted to ALT, the H-CONT [13] circuit generates V. MODE PLS based on A GATE.

This signal enters the IC0502 pin 1 through the J1301 pin 13. The signal, which entered the IC0502, is turned into a channel switch signal and inputted to the IC0601 pin 13 of the A/D BUFF [6] circuit through the J0502 pin 4. This alternately sets *CH1 and *CH2 signals to "H" and "L" in accordance with the A GATE. The CH1 and CH2 signals are alternately led to the delay line drive circuit by alternately turning ON/OFF Q0501, Q0502 and Q0507, Q0508.

For the CHOP Mode

In the CHOP mode, channel switching follows a selection of a fixed frequency, but not A GATE. The original oscillator for the CAL signal oscillates at 256 kHz with a ceramic oscillator X0501 and an inverter (GATE).

This signal is sent to the A/D BUFF [6] as a channel switch signal to switch *CH1/*CH2 "H" and "L" signals. (A CHOP select frequency is 128 kHz.)

In accordance with this signal, the CH1 and CH2 signals are switched and led to the delay line drive circuit.

A CHOP BLK signal is a bright line elimination signal to hold back an unstable condition (noises) which appears when the channel is switched in the CHOP mode. It is sent to the Z-AMP [15] .

For the ADD Mode

When the VERT. MODE swtich is shifted to ADD, a sum of both CH1 and CH2 signals (CH1 + CH2) is led to the DELAY LINE DRIVE circuit.

In the ADD mode, both *CH1 and *CH2 are set to "L", and Q0505, Q0506, Q0511 and Q0512 are turned on. As a current supplied from the DELAY LINE DRIVE circuit runs short, the current is supplied through R0550 and R0551, setting J05020 pin 10 ADD to "H". Thus, both CH1 and CH2 signals are simultaneously led to the DELAY LINE DRIVE circuit.

For the TR1 Mode

When the VERT. MODE switch is shifted to TR1 (both ALT and CHOP modes allowed), the 3-trace mode results and the CH1, CH2 and CH3 input signals are sequentially displayed on the CRT.

When TR1 is selected with a panel switch, the TR1 signal (J0511 pin 3) of the switch is set to "L". The TR1 signal sets to "L" the IC2003 pin 5 and the IC0602 pins 1 and 2 of the A/D BUFF [6] circuit through the V I/O [20] J2002 pin 3, and then, sets the output pin 3 to "H".

With the channel switch signal, *CH1, *CH2 and *CH3 are sequentially set to "L", and the CH1, CH2 and CH3 signals are sequentially set to the DELAY LINE DRIVE circuit.

For the STORAGE Mode

In the STORAGE mode, the *REAL/STORAGE signal of the CPU circuit is set to "H". The *REAL/STORAGE signal enters the circuit [6] from the J2101 pin 11 of H I/O [21] through J2104 pin 3, V I/O [20] , J2001 pin 3, and is inverted at the IC0602 and set to "L". Furthermore, it sets the Q0682 and Q0683 bases to "L", and the J0605 pins 8, 12 and 14 to "L", and is transferred to the V-CONT [5] circuit.

In this circuit, the CH1 signal serves as a switch to turn on which transistor, by controlling the bases of Q0501, Q0503 and Q0505. When Q0501 is turned on, a current to the preamplifier is supplied from Q0501. Therefore, a signal from the preamplifier is not transferred to the other devices. As a current is supplied from the A/D BUFF [6] through the J0601 connector when Q0503 is turned on, the signal is connected to the A/D BUFF. When Q0505 is turned on, the signal is connected to the main AMP as well through Q0529.

Now, take a look at respective base potentials:

Q0501 base *CH1 . . . . . 4.1V at "H" and 0V at "L"

Q0503 base *STORAGE . . . 0V at "H" and 2.25V at "L"

Q0505 base . . . . . Constant at 1.5V

Since *CH1, *CH2 and *STORAGE are set to "L" in the STORAGE mode, the Q0503 base potential becomes the highest and Q0503 is turned on. The signal from the PRE AMP is led to the A/D BUFF [6] .

As the side of Q0502, Q0504, Q0506 and the CH2 is a balancing amplifiers, the same results.

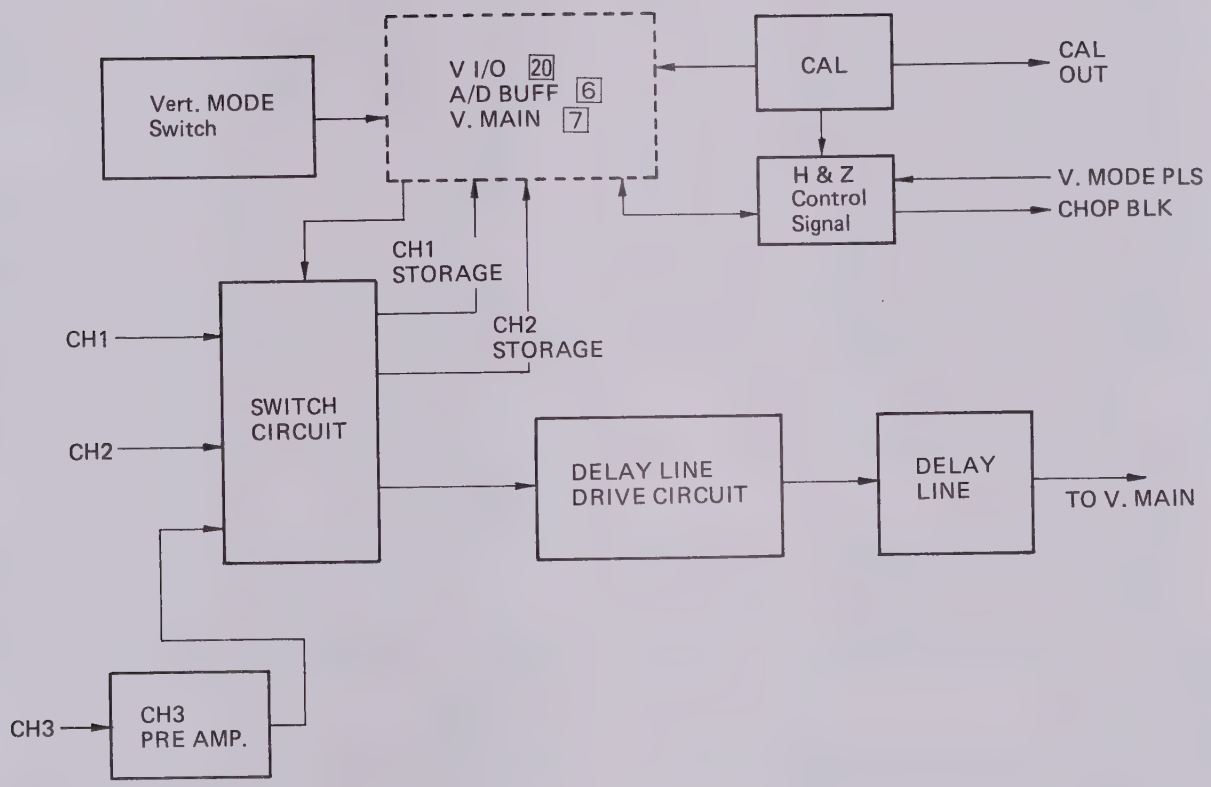
DELAY LINE DRIVE Circuit

This is a negative feedback amplifier using Q0529 and Q0530. This amplifier is driven through the switching circuit by the 2nd-stage amplifier of the PRE AMP.

CAL Circuit

A signal oscillated at a reference oscillation frequency of 256 kHz is frequency-divided into 256 by the IC0503, switched by Q0520 and output as 0.3V by the resistance devider.

Figure 2-2-3. V. CONT Block Diagram



2-2-4 A/D BUFF [6]

For the signals supplied from the switching circuit of the V-CONT [5] in the STORAGE mode, CH1 is connected to the Q0601 and Q0602 bases, and CH2 to the Q0641 and Q0642 bases. For CH1, an input signal is changed into a single output at Q0605 through Q0608 and supplied to the A/D circuit. (A mean potential for the DS-6612 is 0V, and that for the DS-6411 is +1V.)

Q0609 keeps constant the input mean potential of this front-stage amplifier in order to keep constant an output DC level to the A/D circuit. The same goes for CH2. Regardless of CH1, CH2 and DUAL of V. MODE, this amplifier always inputs and outputs the CH1 and CH2 signals when in the STORAGE mode.

The IC0601 through IC0603 generate control signals to control the V-CONT [5] circuit, per control signals from the V I/O [20] .

2-2-5 V-Main Amplifier [7]

This circuit amplifies a signal sent through the delay cable and leads it to the deflecting plate of the CRT.

It also includes a switching circuit for a beam finder, trace separation (in ALT SWEEP mode) and character display.

A signal from the delay cable is divided to the front-stage amplifier, which consists of Q0715, Q0716 and Q717, Q0720, and the rear-stage amplifier, which consits of Q0721 through Q0726.

The beam finder refers to Q0715 and Q0716 collectors short-circuited with D0710 and D0711. Trace separation refers to those collectors which are unbalanced with D0714. When the switch of the beam finder is pressed, the D0710 and D0711 cathodes are grounded through R0745. As a result, load resistances from Q0715 and Q0716 are lowered, thus decreasing an amplification degree.

If the amplification degree is decreased, a waveform outside the CRT can be also allowed inside the CRT to view.

For trace separation, "L" pulses enter the Q0713 base in the ALT SWEEP mode (function which can alternately allow A and B SWEEP and apply an offset to the B SWEEP) when the B SWEEP is indicated, and a negative potential is applied to Q0714. Q0714 is a constant-current circuit and its current amount is determined by a base potential.

Q0713 and D0704 are switches. When the Q0713 base is at "H", a current flows from Q0713 to Q0714 and D0704 is turned off. When the Q0713 base is at "L", the current flows to Q0714 through D0704.

As the current flowing to D0704 is supplied through Q0716, this preamplifier becomes unbalanced to allow an offset to be applied onto the CRT.

Preamplifiers are cascade balancing amplifiers of Q0715 and Q0717, and Q0716 and Q0720. Although load resistors are R0761 and R0762, the cascade balancing amplifier of Q0702 and Q0710 also uses the same R0761 and R0762 as load resistors. This side forms a circuit to display a D/A waveform coming from the character and storage blocks.

Switching is done by the transistors Q0708 through Q0710 and Q0717 through Q0720.

In case of character display, negative pulses enter the P0701 pin 5 to turn on Q0710, and off Q0717 and Q0720. DA-Y inputted to the P0701 pin 2 is amplified at Q0702 and Q0710 and led to the Q0721 and Q0722 bases (rear-stage amplifier).

In case of storage, the P0701 pin 5 remains negative and only signals, which passed through Q0702 and Q0710, enters the rear-stage amplifier. In case of CH1 or CH2 display timing, negative pulses are inputted to the P0701 pins 4 and 3.

When the STORAGE POSITION switch is turned on, the IC0701 pins 1 and 4 are set to "H" to control the analog switch IC0702, thus making STORAGE POSITION valid.

There are two rear-stage amplifiers; one with Q0721 and Q0722, and the other with Q0723 through 0726.

The Q0711 circuit equalizes the mean potentials of the Q0721 and Q0722 bases, so that the mean potential of main amplifier output will be constant.

2-2-6 Sync. Signal Generator (TRIGGER GENERATOR) [8]

The sync. signal generator is a circuit to select a sync. signal source. It consists of a SOURCE circuit, COUPLING circuit which filters a sync. signal, and waveform shaping circuit which amplifies and converts the signal into pulses. The SOURCE circuit selects which one of CH1, CH2, CH3 and LINE is to be used as the sync. signal. The CH1 and CH2 signals enter the P0304, P0801 pin 2 from Q039 and is led to the IC0803 pin 13 via the Q0814 emitter follower. The CH3 sync. signal enters the IC0803 pin 9 via Q0812. The LINE signal enters the IC0803 pin 8 from C1729 via J0521-J0804 pin 4.

The IC0803 is an analog switch and controlled with the information set by the SOURCE switch S0802.

A selected signal is led to the COUPLING circuit via the Q0815 emitter follower.

The COUPLING circuit has AC coupling which allows only AC components to pass, DC coupling which also allows DC components to pass, HF REJ coupling which eliminates high-frequency components, and TV coupling which separates TV sync. components.

They are switched over by the IC0802 analog switch.

The IC0802 is controlled by the IC0804, in accordance with setting of the COUPLING switch S0801.

The AC coupling goes to Q0822 via C0812, and the DC coupling short-circuits C0812. The HF REJ coupling comes out of the analog switch once, passes through Q0806, goes to the analog switch IC0801 via the low-pass filter of R0821, C0811 and C0810, and then, to Q0822 through the IC0802.

TV Sync. Signal Separat Circuit

A synchronizing signal (considered as a composite signal due to TV sync.) coming out of the analog switch IC0801 is inverted of its polarity at Q0805 through C0809 and goes to the analog switch IC0801. Also, the signal inverted at Q0805 is further inverted at Q0803 and led to the IC0801.

Here, either Q0805 output or Q0803 output is selected with the TRIG SLOPE circuit to make sync. signal components of the compositive signal positive. Q0801 inverts that signal, D0801 clamps the lower side of a waveform, and the differential amplifier of Q0802 and D0802 slices and amplifies it. The integration circuit of R0807, C0804 and C0805 generates a TV-V signal, and the differentiation circuit of C0806 and R0809 generates a TV-H signal, and they are respectively led to the analog switch IC0801.

The TV-V and TV-H signals are selected by this switch and led to Q0822 via the IC0802.

A TV-V/TV-H signal select timing is provided by A GATE. In short, the TV-V signal is supplied until the A SWEEP starts, and the TV-H signal is supplied after it starts.

The sync. signal via the SOURCE circuit and COUPLING circuit is the Q0822 source follower and Q0824 emitter follower. Similarly, the potential set with the TRIG LEVEL knob is supplied to the Q0821 source follower and Q0823 emitter follower.

The sync. signal and the potential set with the TRIG LEVEL knob are connected to the respective differential amplifier bases which consist of Q0825 and Q0826. These Q0825 and Q0826 are transferred to the IC0901 (ECL) of the sync. signal waveform transform circuit of the A-SWEEP GENERATOR at the next stage.

2-2-7 A SWEEP G. [9]

The A-SWEEP G. has two circuits; one to receive a trigger signal and produce trigger pulses by transform a trigger signal waveform, and the other to input the trigger pulses to the SWEEP CONTROLLER and control the SWEEP GENERATOR.

TRIG Waveform Transform and TRIG SLOPE Circuits

The sync. signal amplified at Q0825 and Q0826 are input to one side of the IC0901 pin 15 (EXCLUSIVE OR/NOR gate). The sync. signal, which was turned into a pulse signal with hysteresis applied at R0901 and jitter reduced, is input to another gate (exclusive OR/NOR) of the same IC. The other input is set to either "H" or "L" by the TRIG SLOPE circuit and a trigger slope is realized by altering the output polarity of this exclusive OR/NOR gate. The signals, which are outputted from the output pins 2 and 3 of this gate at the ECL level of mutually reverse polarities, are level-converted to the TTL level at Q0901, Q0902 and Q0913, and trigger pulses are transformed into constant length pulses at the pins 4, 5, 6 and those 1, 2, 3 of the IC0905's NAND gate and input to the SWEEP CONTROLLER.

SWEEP CONTROLLER

This consists of the IC0902 and IC0903. Sync. pulses are input to the IC0903 pin 1, and the SWEEP GENERATOR is controlled through the output Q pin 5 of this IC. The SWEEP MODES AUTO, NORM and SINGLE are controlled by controlling IC0903's J, SD and CD per another flip-flop of the IC0903 and the H-CONT [13] .

The monostable multivibrator, which consists of the IC0902 pins 1, 2, 3, 4, 13, 14 and 15, receives trigger pulses, and $\overline{Q}$ is held at "L" for about 20 ms.

When the SWEEP MODE is AUTO, this output $\overline{Q}$ signal is received and turned into an AUTO SET signal through the H-CONT [13] , and by controlling IC0903 pin 4 $\overline{SD}$, it determines whether the SWEEP GENERATOR is to be self-generating oscillated or symchronously oscillated.

A jitterless circuit for high-frequency signals is formed by the monostable multivibrator (consisting of the IC0902 pins 5, 6, 7, 9, 10, 11 and 12) and the flip-flop (consisting of the IC0903 pins 7, 9, 10, 11, 12, 13 and 14).

SWEEP GENERATOR

The SWEEP GENERATOR consists of Q0903 through Q0909 and TIMING CR of the A TIMING [10] . Before starting a sweep, IC0903 pin 5 Q is at "L" and Q0903 is OFF. The SWEEP GENERATOR output Q0908 emitter is fed back by the loop of Q0904, Q0905, D0906, Q0907, Q0908, R0920, Q0909 and Q0904 so that it results in 2V. It compares the Q0904 emitter (GND) and the Q0909 base and works so that they are always the same. In short, if the Q0909 base increases, so does the Q0909 emitter, and the collector potential is lowered because a Q0904 base current flows more. Then, it is carried to Q0905, D0906, Q0907 and Q0908 to decrease the Q0908 emitter and Q0909 base. In this loop, the Q0908 emitter, that is, a sawtooth wave start point is made constant. In this state, Q0906 is OFF.

A sweep starts when IC0903 pin 5 Q is set to "H". IC0903 output "H" turns Q0903 on, Q0904, Q0905 and D0906 OFF, charging starts to the condenser (TIMING C) connected to the Q1012 collector from the constant-current source (TIMING R) attached to the Q1012 emitter side. The gate potential of Q0907 increases gradually. This potential becomes sawtooth output through the Q0907 source follower and the Q0908 emitter follower.

The Q0906 emitter follower is provided to turn off Q0905 and D0906 to keep a reverse bias potential at a consttant level.

The generated sawtooth output is voltage-divided at R0925 through R0926 and led to the Q0911 base. As it then enters the IC0904 pin 11 through the Q0911 and Q0910 emitter followers, the potential here increases gradually. When the IC0904 pin 11 exceeds a threshold level, the output pin 10 is set from "H" to "L" and the IC0903 pin 14 is set to "L" to set output pin 7 $\overline{Q}$ from "L" to "H".

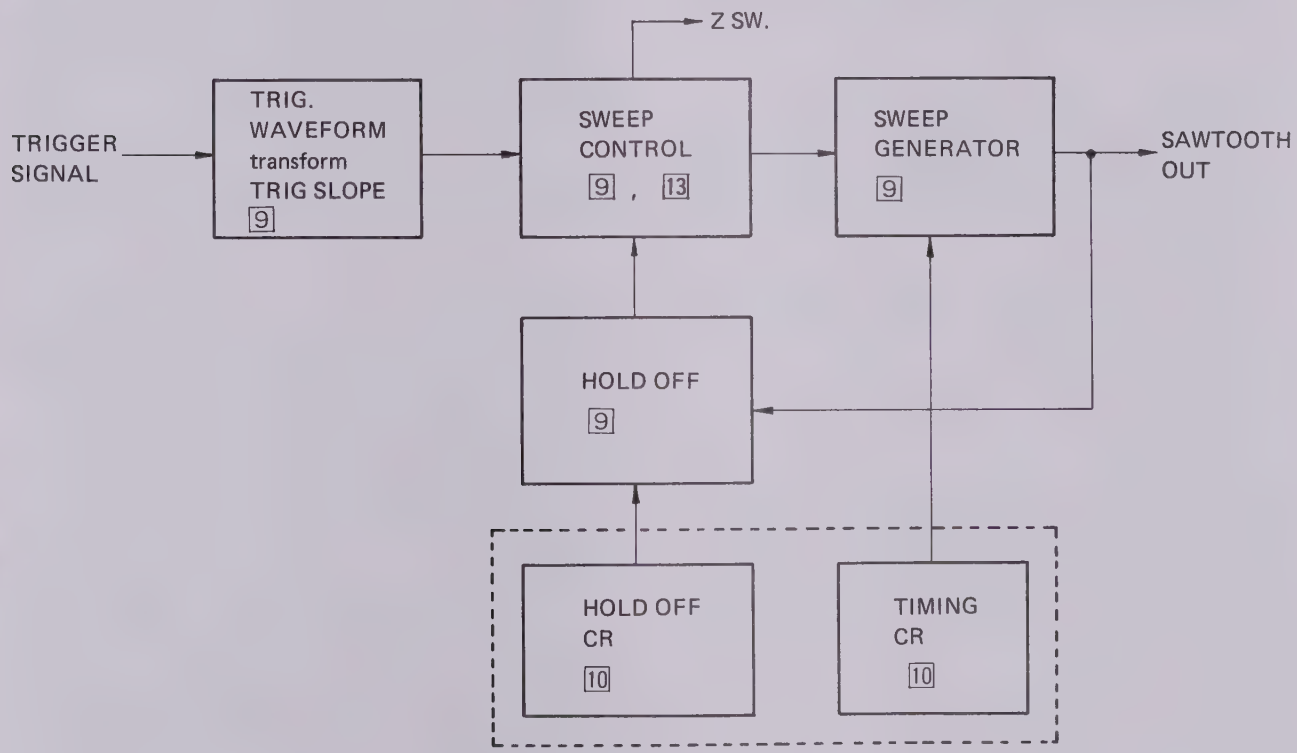
With the IC0903 pin 15 being set to "L" by inversion of the IC05 pins 8, 9 and 10, output pin 5 Q is set to "L". Then, Q0903 is turned off, Q0904 is turned on, and the electric charge charged to the TIMING C is discharged flowing through D0906, Q0905 and Q0904, and the Q0907 gate potential is lowered down to a start point to stabilize there.

HOLD-OFF Circuit

When the sweep ends and an output potential starts coming down, the Q0911 potential base, which was voltage-divided at R0925 through R0927, is also lowered. An emitter potential is discharged at --10V at C0920, C1011-C1015, R1036 and R0928. It is lowered with a time constant. It has been set so that it will be lowered more slowly than the Q0911 base potential. A Q0911 emitter potential lowering time can be adjusted with the R0928 HOLD OFF VR.

The Q0911 emitter output enters the IC0904 pin 11 through the Q0910 emitter follower. When that level comes lower than the threshold level of the IC0904 pins 10 and 11, the output pin 10 is set to "H" to set the IC0903 pin 14 to "H". When a clock (trigger pulse) enters the pin 13, output pin 7 $\overline{Q}$ is set from "H" to "L" and inverted at the IC0905 pins 8, 9 and 10 to set the IC0903 pin 15 to "H", thus waiting for trigger pulses.

Figure 2-2-7. A-SWEEP GENERATOR Block Diagram



2-2-8 A TIMING CIRCUIT [10]

This circuit switches the TIMING CR HOLD OFF CR for the A sweep generator in accordance with the setting of the SEC/DIV rotary switch.

TIMING R

The "H" and "L" signals set with the rotary switch S1001 pass through D1001-D1005 and are decoded at the IC1002, IC1001 and D1006, D1007, Q1001.

R for the constant-current circuit is switched by controlling the Q1002 through Q1011 (up to Q1010 for DS-6411) base potentials.

The constant-current circuit is formed by connecting the TIMING R R1016-R1027 to the Q1012 emitter.

TIMING C

The current produced by the transistor switch TIMING R (Q1012, Q1002 through Q1011) is charged to the TIMING C (C1007 through C1009, C0913, C0914) through the Q1012 collector. C0913 and C0914 are always connected.

C1007 through C1009 are decoded by the IC1003 in accordance with the setting of the SEC/DIV switch to turn on/off the relays RL1001 and RL1002.

HOLD OFF CR

HOLD OFF C is C0920 and C1011 through C1015. Same as the other ones, they are decoded by the IC1003 in accordance with the setting of the SEC/DIV switch and C1011 through C1015 are switched by the IC1004.

C0920 is always on. HOLD OFF R is R1036 and R0928.

2-2-9 B SWEEP G. [11] and B TIMING Circuit [12]

The B SWEEP G. performs a delay sweep, based on the A sweep generator. It consists of the DELAY PICKOFF COMPARATOR, to which A SAWTOOTH and DELAY TIME set values are inputted, SWEEP CONTROL, SWEEP GENERATOR, and SWEEP STOP COMPARATOR.

TIMING CR is the B TIMING circuit [12] .

DELAY PICKOFF COMPARATOR

A SAWTOOTH is voltage-divided at R1101 and R1102 with its amplitude approximately halved and enters the comparator IC1102 pin 3 ⊖ input terminal through the Q1101 emitter follower. The signal, where digital setting from the CPU was converted into an analog voltage by the IC1304 of the H-CONTROL [13] circuit, comes in through the IC1305 buffer amplifier.

The "L" signal is outputted to the IC1102 output terminal pin 7 when a sawtooth potential becomes higher than the potential set by the IC1304 D/A.

SWEEP CONTROL

This circuit CONTROLS and B SWEEP GENERATOR in accordance with DELAY PICKOFF PULSES.

Its operations are as follows:

It oscillates the SWEEP when H. DISPLAY is set to A INTEN, B DLYD or ALT.

It oscillates the B SWEEP once per A SWEEP.

When the A SWEEP ends, it terminates the B SWEEP as well.

In the Equivalent Sample mode, however, it performs the B SWEEP to the last.

It selects whether to start the B SWEEP with a signal f from the DELAY PICKOFF comparator or with a subsequent trigger pulse. (RUNS AFTER DELAY, TRIG'D)

First, whether to oscillate the B SWEEP follows a signal from the H-CONT [13] . When the NAND output pin 6 for the IC1101 pins 4, 5 and 6 is set to "L", IC1103 pin 15 $\overline{CD}$ is set to "L", and the B SWEEP is stopped by setting output Q to "L".

To generate the B SWEEP, you must set either IC1101 pin 4 or 5 to "L" and an output to "H".

In a wait condition after the B SWEEP (RUNS AFTER DELAY), the IC1104 pins 1 and 2 are set to "H" and the pin 3 to "L". At the IC1103 upper flip-flop, pin 15 $\overline{CD}$ is set to "L", pin 3 J to "L", and pin 4 $\overline{SD}$ to "H". The output Q is set to "L" and $\overline{Q}$ to "H", and the B SWEEP GENERATOR has returned to a start point.

When the IC0904 pins 3, 4, inverter pin 3 are set to "L", its pin 4 to "H", the IC1103 lower flip-flop pin 13 to "H", pin 14 to "H" and pin 10 to "L", the output $\overline{Q}$ pin 7 is set to "L", and when the NAND pins 4 and 5 for the IC1104 pins 4, 5 and 6 are at "L", the pin 6 is set to "H".

When *A GATE comes in, the IC1101 pin 1 is set to "L" and pin 3 to "H". At the same time when the lower flip-flop pin 10 $\overline{SD}$ of the IC1103 is set to "H", it is delayed by the two NAND gates for the IC1101 pins 11, 12, 13, and 8, 9, 10.

As negative pulses differentiated by C1104 and R1109, R1110 enter the pin 14 $\overline{CD}$ of the same flip-flop, the output $\overline{Q}$ pin 7 is set to "H" from "L", thus setting the IC1104 pin 4 to "H".

Next, when the A sweep starts and negative pulses enter from the delay pick off circuit, the flip-flop, which consists of the IC1104 pins 1, 2, 3 and 4, 5, 6, sets those 3 and 5 to "H" and 6 and 1 to "L", as the negative pulses enter the pin 2. When the pin 3 is set to "H", the IC1103 upper flip-flop pin 15 is set to "H" and the pin 4 to "L". As a result, the output Q pin 5 is set to "H" and $\overline{Q}$ pin 6 to "L". When the Q pin 5 is set to "H", the B SWEEP GENERATOR generates a sawtooth wave. The sawtooth output is voltage-divided at R1127 and R1128A, B. The output of the Q1110 emitter follower increases the IC0904 pin 3, and when it exceeds a threshold level, the output pin 4 is set to "L", the IC1103 pin 13 $\overline{CP}$ is set to "L", and the output $\overline{Q}$ pin 7 to "L". Of the flip-flop which consists of IC1104's two NAND gates, the pin 4 is set to "L", pin 6 to "H" and pin 3 to "L". Then, the IC1103 upper flip-flop $\overline{CD}$ pin 15 is set to "L" and $\overline{SD}$ pin 4 to "H", thus setting the output Q pin 5 to "H" to terminate the B SWEEP. If a B SWEEP output potential is lowered, the IC0904 pin 4 is set to "H", resulting in a wait condition again.

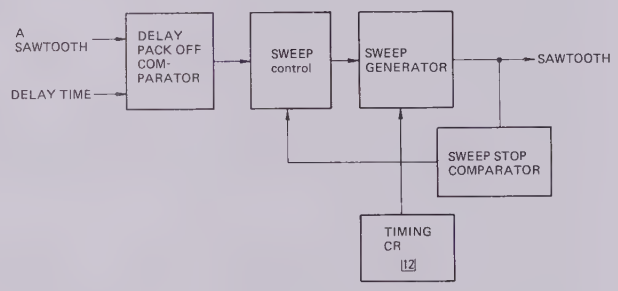
If *A GATE is set to "H" (A sweep terminated) halfway the B SWEEP, the IC1103 lower flip-flop pin 10 $\overline{SD}$ is forced to "L". Along with it, the output $\overline{Q}$ pin 7 is also set to "L" to terminate the B SWEEP.

In the Equivalent Sample mode, however, no data is obtained unless the B sweep is terminated. So, *ST-EQ is set to "L" to always hold the IC1103 pin 10 $\overline{SD}$ at "H".

If the B SWEEP mode is set to TRIG'D, a B MODE signal is set to "L" and the IC1103 upper flip-flop pins 4 $\overline{SD}$ and pin 3 J are both set to "H".

The pin 15 $\overline{CD}$ is set to "H", and next, negative pulses enters $\overline{CP}$ and the output pin 5 Q is set from "L" to "H".

Figure 2-2-9. B SWEEP G. Block Diagram



2-2-10 H-CONT [13]

The H-CONT circuit consists of a circuit, which CONTROLS the SWEEP GENERATOR with signals such as SWEEP MODE, HORIZ DISPLAY, TRIG LEVEL and TRIG SLOPE, and another circuit, which selects signals to the H-AMP and Z-AMP, and so on.

SWEEP GENERATOR CONTROLLER

This consists of a circuit which issues an A SWEEP GENERATOR sweep end signal in accordance with the setting of the SWEEP MODE (AUTO/NORM/SINGLE) switch, and a circuit which controls the A SWEEP GENERATOR with the IC1302 and IC1303 by receiving whether self generating in the AUTO mode in allowed, and an INHIBIT signal from the CPU.

It sets the AUTO or NORM or SINGLE mode with S01-1.

The AUTO mode, where this switch output is "H", has no sync. signal and makes valid the gates (IC1302 pins 8, 9, 10 and 11) which cause the A SWEEP GENERATOR to be self-generated.

The NORM and SINGLEmodes sets the output of S01-1 to "L" and disables self-generated oscillations (the A SWEEP GENERATOR is activated with trigger pulses only) by forcing to "H" the gate outputs of the IC1302 pins 8, 9, 10 and 11.

The other S01-1 and S01-2 switches set a selection among AUTO/NORM/SINGLE. This output controls the flip-flop formed by the 2 NAND gates of the IC1302 pins 1, 2, 12 and 13, and those 3, 4, 5 and 6.

In the non-SINGLE mode, a switch output is set to "L" and both flip-flop outputs are always set to "H" to enable AUTO- or NORM-mode operation by eliminating the effects of a SWEEP RET signal caused by an AUTO STOP signal.

In the SINGLE mode, the pins 1, 2 and 3 are set to "H" in the flip-flop formed by the IC1302.

When the "L" signal of SWEEP RET ( ) enters, the IC1302 pin 4 is set to "L", the output pin 6 is set to "H" and the other output pin 12 is set to "L", and as a result, the IC1303 pin 12 is set to "H" and pin 8 (AUTO STOP) to "L" to stop a sweep.

When a RESET signal enters, it sets the pin 1 to "L" temporarily, output pin 12 to "H", IC1303 pin 12 to "L" and pin 8 (AUTO STOP) to "H" to causes a sweep wait condition, and at the same time, it sets the flip-flop IC1302 pin 15 to "H". Therefore. (if the sweep has been completed), the pin 4 is set to "H", pin 6 to "L" and pin 13 to "L", and the pin 12 is held at "H".

Also, as the pin 12 is at "H", D1306 is turned off, and as D1305 is also off, the D1302 READY LED is turns on through Q1301.

When the sweep starts and a sawtooth wave rises, SWEEP RET is set to "L", and the IC1302 pin 6 is set to "H" and pin 12 to "L" (at the same time, D1306 is turned on, the Q1301 base potential is lowered and the LED turnes off), thus prohibiting the next sweep. When the RESET switch is pressed again, the IC1302 pin 1 is set to "L" and pin 12 is set to "H" to result in a sweep wait condition.

Signal Selections to H-AMP. and Z-AMP.

Selections are made by signals HORIZ DISPLAY, VERT MODE (X-Y) and STORAGE.

Table 2-2-10-1 Signal Selection to H-AMP.

	HORIZ DISPLAY				Vert MODE	STORAGE
Input Signal	A	A INTEN	B DLY'D	ALT	X-Y	
A SAWTTOTH	O	O	X	alternate	X	X
B SAWTOOTH	X	X	O		X	X
CH1 SIGNAL	X	X	X	X	O	X

An input signal selection to the H-AMP. follows Table 2-2-10-1 and the circuit cuts off unrequired signals.

When HORIZ DISPLAY is A and A INTEN, only A SAWTOOTH is allowed to pass with B SAWTOOTH and CH1 signals cut off. D1355, D1356 and Q1351 are turned on, and D1353, D1354 and D1357 are turned off. When HORIZ DISPLAY is B DLY'D, D1354, D1357 and Q1351 are turned on, and D1353, D1355 and D1356 are turned off. In the ALT (sweep) mode, D1356 and D1357 are alternately turned on upon every sweep to select between A SAWTOOTH and B SAWTOOTH in turn.

D1356 and D1357 are turned ON/OFF by the inverter for the open collector of the IC1312 pins 12, 13, 10 and 11. This is controlled by the IC1314's flip-flop. This flip-flop sends out specified outputs in accordance with HORIZ DISPLAY setting and VERT. MODE setting.

In the STORAGE mode, D1353, D1354 and D1355 are turned off by Q1353 and IC1401 pins 8, 9, 10 and 11, and A SAWTOOTH, B SAWTOOTH and CH1 signals are turned off. Insetead, D1406 of the H-AMP. [14] is turned on Z-AMP.

A signal selection to the Z-AMP. is done through the input block of the Z-AMP. [15] . This block produces control signals and sends them to the Z-AMP.

Table 2-2-10-2 Output Data by Horiz Display

	HORIZ DISPLAY			X-Y
	A	A INTEN	B DLY'D	
A KILL	H	L	L	L
INT KILL	L	H	L	L
B KILL	L	L	H	L

The control signals as shown in Table 2-2-10-2 are sent to the Z-AMP. Details for their switching are provided in 2-2-12 Z-AMP. [15] .

When the VERT. MODE is ALT, the IC1315 serves as a circuit for supplying a SWEEP GATE signal.

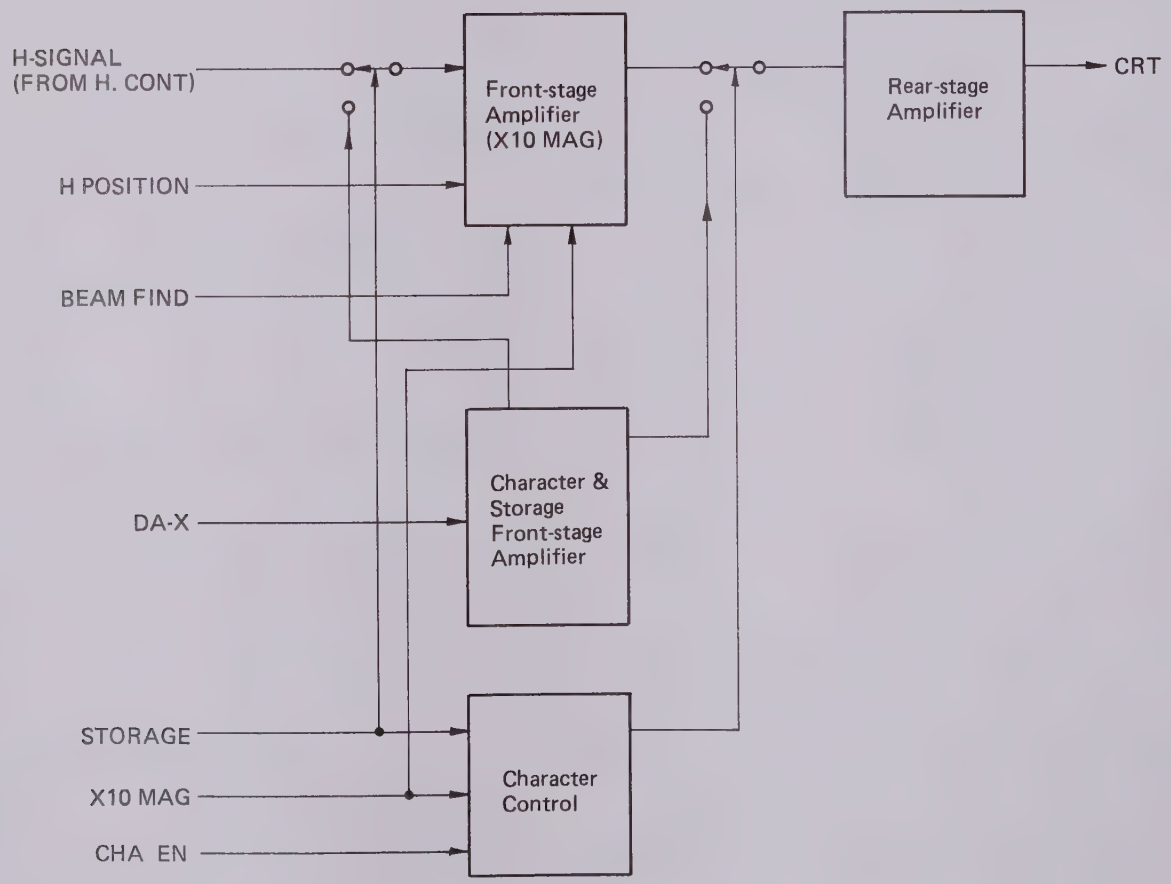
TRIG LEVEL and TRIG SLOPE operational information is supplied to the TRIG G. [8] and A-SWEEP G. [9] through J1301 and J1311.

The IC1304 is a D/A converter for setting a delay sweep delay time. Its output is supplied to the B-seep G [11] through the IC1305 buffer amplifier.

2-2-11 H-AMP [14]

The H-amplifier consists of the front-stage amplifier (having the X10 MAG function) which receives the H-SIGNAL and H-POSITION signals selected in the H-CONTROL circuit and gives them as balancing outputs, the character and storage front-stage amplifier which receives a DA-X signal, the character control which controls a selection between the H-SIGNAL and character signals, and the rear-stage amplifier which supplies an X-axis signal to the CRT.

Figure 2-2-11-1. H-AMP Block Diagram



Front-stage Amplifier

Q1401 is a twin transistor, each of which configures a negative feedback amplifier. One of them receives the H-SIGNAL signal and the other the H POSITION signal, and they send the signals to Q1404 and Q1405, respectively. In the STORAGE mode, the DA-X signal enters the input on the H SIGNAL side. The Q1401 amplifier is followed by the cascade amplifier composed of Q1404, Q1410 and Q1405, Q1411. The base grounded transistors Q1410 and Q1411 of this amplifier selects between a character storage waveform and the H SIGNAL. The X10 MAG function is realized by increasing an amplification factor by adding R1419 and R1422 in parallel with the resistors R1423 and R1424 contained in the emitter common to Q1404 and Q1405, by means of the relay RL1401.

A current is supplied to this cascade amplifier through Q1406. The BEAM FIND function increases this transistor base potential to reduce a supply current and narrows a CRT display area by saturating this amplifier quickly.

Character & Storage Front-stage Amplifier

The DA-X SIGNAL enters the Q1420 base and Q1429 base. The cascade differential amplifier is formed by the Q1420 twin transistor, Q1424 and Q1425, and a switch is formed by front-stage amplifier's base grounded Q1410 and Q1411 and this circuit's base grounded Q1424 and Q1425 to select between the H and DA-X SIGNALS.

The DA-X SIGNAL, which enters Q1429, is connected to the H signal input block through D1406 after the Q1429 emitter follower. In the STORAGE mode, however, the DA-X signal is input to the Q1401 base, inplace of the H SIGNAL.

Character Control

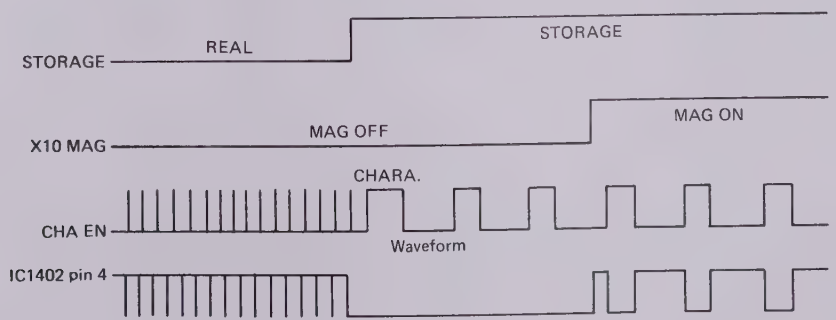
When leading a front-stage amplifier signal to the rear-stage amplifier, the IC1402 pin 4 is at "H", and when leading the character and storage front-stage amplifier, the IC1402 pin 4 is at "L". In the REAL mode, it is switched in accordance with a CHA EN signal. In the STORAGE mode, however, it depends on whether X10 MAG is ON or OFF. When X10 MAG is off, the rear-stage amplifier is entirely connected to the character and storage front-stage amplifier. When X10 MAG is on, the front-stage amplifier (X10 MAG) is connected at a waveform timing to enable both the X10 MAG and H POSITION functions.

Rear-stage Amplifier

X+ and X– are amplified and directed to the CRT by two negative feedback amplifiers of Q1412, Q1414 through Q1416, and Q1413, Q1417 through Q1419, respectively.

In order to make constant the X+ and X– mean potentials, Q1427 is installed bacause it is necessary to make constant the Q1412 and Q1413 base input mean potentials.

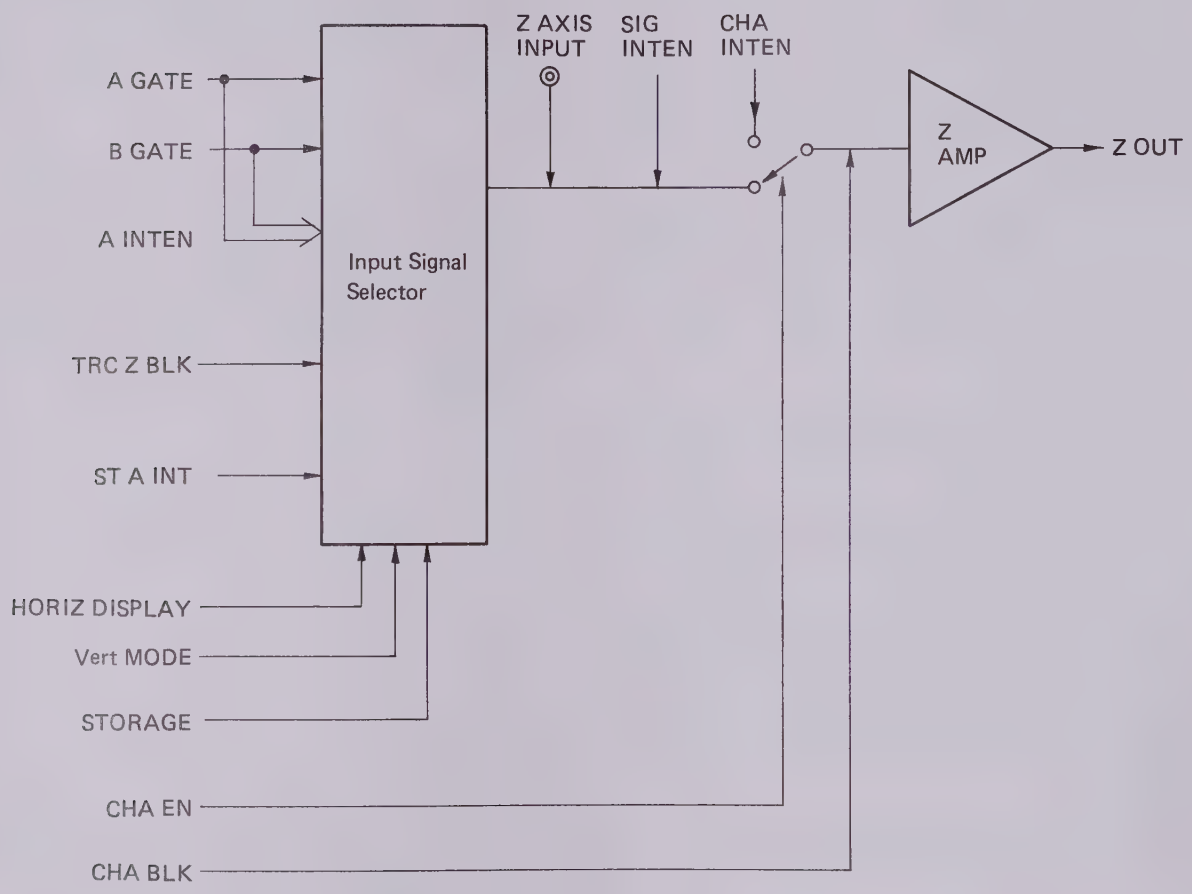
Figure 2-2-11-2. Character Control Timing Chart



2-2-12 Z-AMP [15]

The Z-AMP is a circuit for adjusting CRT intensity.

Figure 2-2-12-1. Z-AMP Block Diagram



The input selector is a diode switch. In the REAL mode, it selects *A GATE/*B GATE signal in accordance with HORIZ DISPLAY.

When the VERT. MODE is CHOP, it allows a signal to pass, which erases a channel select timing, and for the X-Y mode, it turns off *A GATE and *B GATE to set them at fixed levels at R1508 and R1509.

In the STORAGE mode, it turns off the *A GATE, *B GATE and INT SIGNALS and the X-Y level and issued a intensity level with R1548 at a timing of a TRC Z BLK signal. ST A INT is a intensity modulation signal at A INTEN time in the STORAGE mode.

A signal from the input signal selector adjusts entire intensity with SIG INTEN and makes a selection between CHARACTOR and others.

The intensity level in the CHARACTER mode is determined by CHARACTOR INTEN (R1911) and switched at Q1502 through Q1505 by a CHA EN signal.

Same as the H-AMP, the Z-AMP forms a negative feedback amplifier and supplies to the HV & CRT [16] Z OUT. Its input assumes the form of leading out a current through D1522.

The led-out current is combined with a current flowing through D1521 from the switching circuit and led by a constant current consisting of Q1507 and R1526.

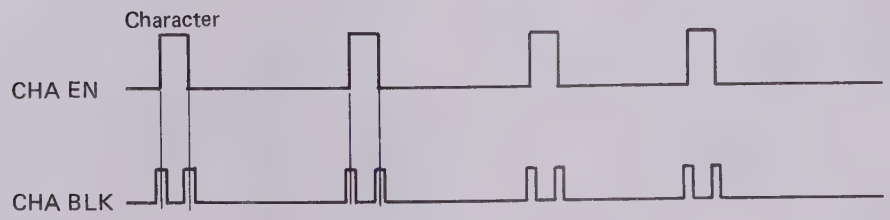
First, if the SIG INTEN knob is turned clockwise (R1908 of VR19), a current flowing through R1514 is increased.

Since a current from R1522 to Q1502 is increased, that for D1521 is decreased. As a total of currents flowing from D1521 and D1522 is constant, the current through D1522 is increased by a current amount decreased at D1521, the Z-AMP output potential is raised, thus increasing the intensity on the CRT.

As characters are displayed with dots, CHARACTERS are displayed with dots. CHA BLK signal erases switching noises before and after.

When the CHA BLK signal is set to "H", the Q1506 base potential is increased and a current flows to the Q1507 emitter resistor R1526 through Q1506 and D1524. So, Q1507 is turned off, Z OUT is lowered because no current flows through D1522, and the CRT is darkened, thus erasing before and after CHA EN.

Figure 2-2-12-2.



2-2-13 HV & CRT [16]

This unit consists of the high-voltage generator and various power supply circuits fro the CRT.

Oscillation for High-voltage is done by positively feeding back through T1601 based on a change of Q1601 collector current and about 40 kHz.

It doubly voltage rectifies the secondary winding terminals pins 7 and 9 of T1601 with C1609, D1608, D1607 and C1610 to use them as CRT cathode electrodes, and at the same time, controls a Q1601 (oscillation transistor) base current to keep a output voltage cathode at –1.75 kV by feeding back to the OP AMP IC1601 with R1617, R1619, R1632 and R1608, R1609 and controlling the Q1602 base potential.

An AC power from the T1601 pins 5 and 6 is supplied to the CRT heater by placing it on the cathode potential with R1631.

An AC large amplitude signal from the T1601 pin 8 is supplied to the first grid, slicing it by the INTEN ADJ potential and Z OUT signal, doubly voltage rectifying it with D1604, C1607, D1605 and C1608, and lowering it below the cathode with D1606 by that potential amount.

To P3, AC outputs of the T1601 pins 7 and 9 are supplied at about 10.5 kV, rectifying them 12 times with M1601.

For P1 (FOCUS), they can be adjusted with one (R1632) of the feedback resistors used for stabilizing a cathode voltage.

The TRACE ROTATION control knob for the ROTATION COIL is shown in the circuit diagram for the VR [19] .

2-2-14 POWER [17]

Four kinds of supply voltages (100V, 115V, 220V and 230/240V) can be selected and used with a plug.

The secondary power source consists of 4 series regulators and 4 3-terminal regulators.

Series regulators are for –9.8V, +10V, +50V and +120V; –9.8V is a reference one and is adjusted with R1737. Each circuit has an overcurrent protective circuit incorporated. (–9.8V: R1733, R1734, Q1719; +10V: R1727, R1728, Q1715; +50/+120V: R1719, Q1713)

The 4 3-terminal regulators are as follows:

- Analog +5V: IC1703
- Analog –5V: IC1704 (DS-6612 only)
- Digital +5V: IC1701
- +12V for fan motor: IC1702

In addition Provided in addition to the above are a power supply for the HV, that for the SCALE ILUM LAMP, fuse (F1701) and line synchronizing filter (R1739, R1740, C1728 and C1729).

2-2-15 POS [18]

This is a circuit for VERT. POSITION operation.

2-2-16 VR [19]

This is a circuit for CH3 POSITION and H POSITION. It is located at the lower part of the CRT.

Turning CHARACTOR INTENSITY counterclockwise activates the Q1903 and Q1904 comparators, turns on Q1903 and Q1905 and sends a negative signal to "CHA OFF."

2-2-17 V I/O [20] , H I/O [21]

The V I/O and H I/O interfaces between the operation of the oscilloscope mentioned so far and the CPU.

This consists of a circuit which operates circuits through panel operation of the oscilloscope, circuit which sends setting information and operational information to the CPU, and circuit which causes the CPU to make settings and operate.

The V I/O is related to the vertical system, and H I/O to the horizontal system. The CPU is first connected to the H I/O, and then, to the V I/O.

To send oscilloscope operational information to the CPU, make paralled-to-serial conversion. To set the circuits from the CPU, make serial-to-parallel conversion. These bidirectional conversions are done with one IC, CD026A. (CD026A is an 8-data serial/parallel, parallel/serial conversion IC.)

With 8 ICs (IC2001, IC2002, IC2003, IC2103, IC2104, IC2105, IC2106 and IC2107) chained together, this IC can collect and set 64 ports worth (8 ports x 8 ICs) of data at one time. In fact, however, there is also only one directional function available, which is determined by the IC's I/O SEL.

For a CD026A function in case of input, the I/O SEL is at "H" and D0-D7 are of input. If there is an input to these inputs, a negative pulse is output to *DREQ. Receiving this pulse, data is latched by inserting a rise edge into *DLST. Next, if one pulse (rise edge) is inserted into SCLK, latched data is shifted by one.

Therefore, if 8 pulses are input, 8 latched data appears at DOUT in accordance with that timing. This way, data is converted from parallel to serial and read by the CPU.

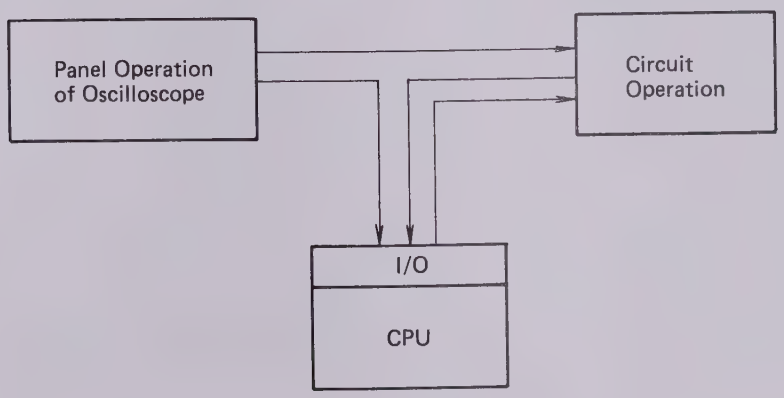
When the I/O SEL is at "L", D0-D7 are of output. Data is shifted one by one by inserting a pulse (fall edge) into SCLK and data into SDIN, and data is latched and output to D0-D7 by inserting the fall edge into DLST.

The IC2001 and IC2002, where the I/O SEL is connected to +5V, are for INPUT only (read only from the CPU), whereas the IC2106 and IC2107 connected to GND are for OUTPUT only (only setting from the CPU).

The ICs are set to either INPUT or OUTPUT, depending on whether a device condition is LOCAL or REMOTE.

The other inputs and outputs from the CPU first enter this circuit and transmitted to each circuit.

Figure 2-2-17.



In addition to handshaking in Table 2-2-17, the circuits RL2101 and RL2102 switch A SAWTOOTH, B SAWTOOTH, A GATE and B GATE signals in the Equivalent Sample mode.

Table 2-2-17

	Viewed from CPU	Remarks
RESET OUT	INPUT	Checks whether reset or not in the SINGLE mode.
INHIBIT	OUTPUT	Holds back a sweep until the CPU is ready.
*SINGLE RESET	OUTPUT	Single reset from the CPU
*GND REF	OUTPUT	Sets an input to GND when capturing GND data.
*ST-EQ	OUTPUT	Output at equivalent sampling time in the STORAGE mode
*REAL/ STORAGE	OUTPUT	Condition output
GATE OUT	INPUT	Used as a trigger for digital storage.

2-2-18 CPU and Memory 51

(1) CPU HD64B180 (IC8N)

(2) ROM 27C512 (IC6N). All software for this equipment is contained in this ROM.

RAM SRAM 256 K (32 KB x 8 bits)

The DS-6612 uses one IC6M and one IC6N. The IC6N is a save memory area of itself. The DS-6411 uses one IC6M. (no save function provided) The IC6N has no IC.

Although the IC11J 54 contains NVRAM, it is mainly for an interface. (stated later)

2-2-19 Reference Clock 51

X01 is a reference clock for the CPU. A 12.288 MHz quartz oscillator is used. The reference clock is frequency divided into two inside the CPU and system clock (6.144 MHz) is output from the CPU IC8N pin 64.

The system clock is supplied to 2 places:

① It is further frequency-divided into two by the 53 IC3E pins 1, 2, 3, 4, 5 and 6 and supplied to the 53 IC3M (DM KEY CONTROLLER).

② As a clock for the GP-IB and RS-232C interfaces, it is connected to the J5402 pin 2 through the 54 IC11N.

2-2-20 Reset Circuit 51

The IC3M (MB3771) is an IC for monitoring the power source. The IC3M pin 7 is a supply voltage detection terminal. R5101 and R5103 are resistors for finely adjusting a detection voltage. When the pin 7 is 1.24V or less (4.4V or less in terms of supply voltage), pin 8 *RESET is set from "H" to "L" to reset the system.

When restoring the power source, pin 8 (RESET is set from "L" to "H" 10 ms after when the pin 7 is greater than 1.24V (4.4V for the +5V power), thus clearing reset.

In addition to the IC8N CPU, *RESET is connected to the following 5 circuits:

① IC9L pin 4 (DMA control circuit)

② IC2J (status latch circuit, described later) through the 52 IC4L, 3K

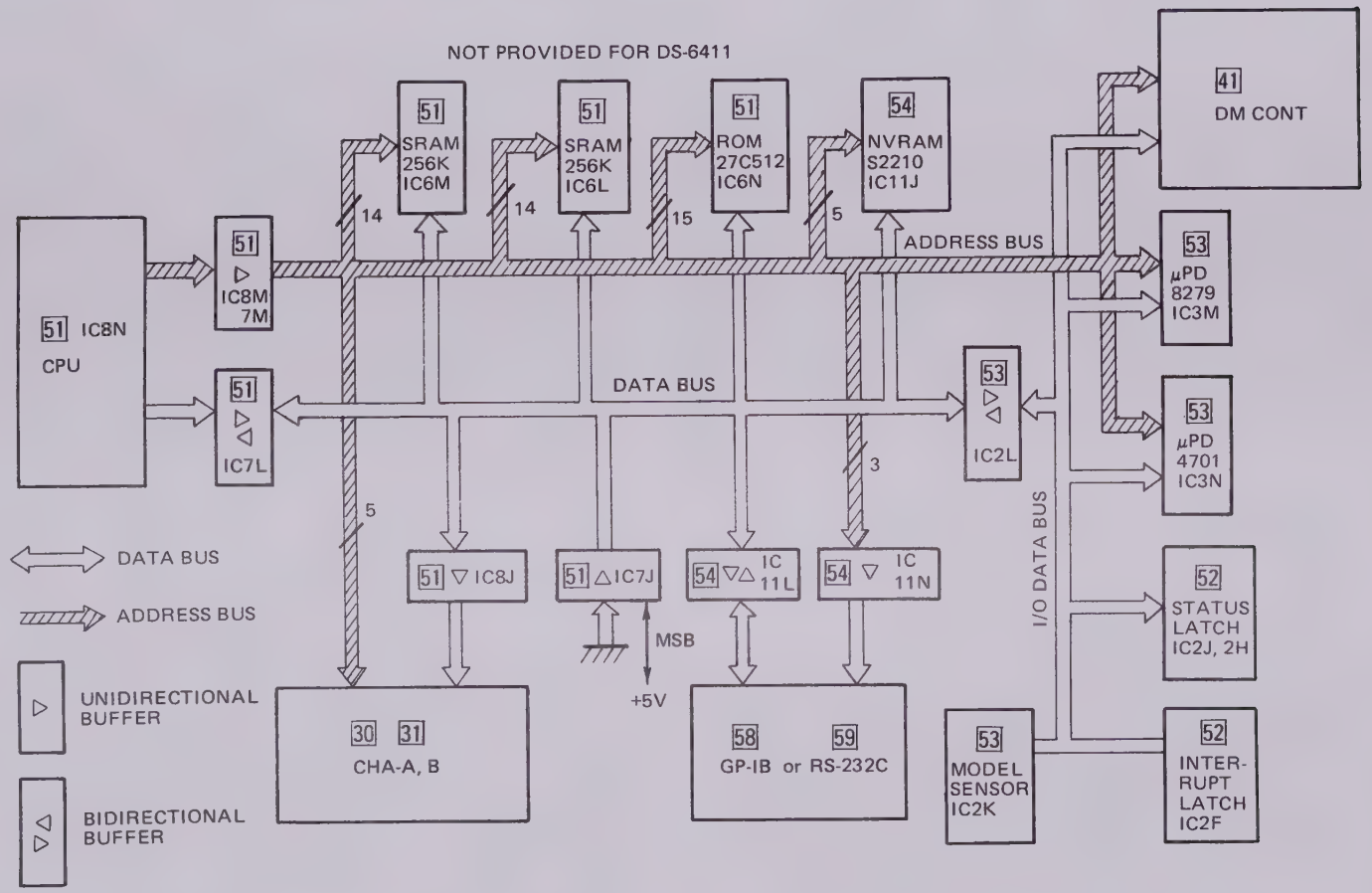
③ J5402 pin 1 through the 54 IC11N (for GP-IB, RS-232C)

④ 31 IC4H pin 21 (CDP)

⑤ 53 IC3M through the 53 IC3J with logic inverted by the IC4P pins 11 and 10

In addition to the connection shown above, the address bus is connected to each I/O decoder.

Figure 2-2-20. CPU Data Bus and Address Bus Configuration [51] through [54]



2-2-21 80H Data Buffer [51]

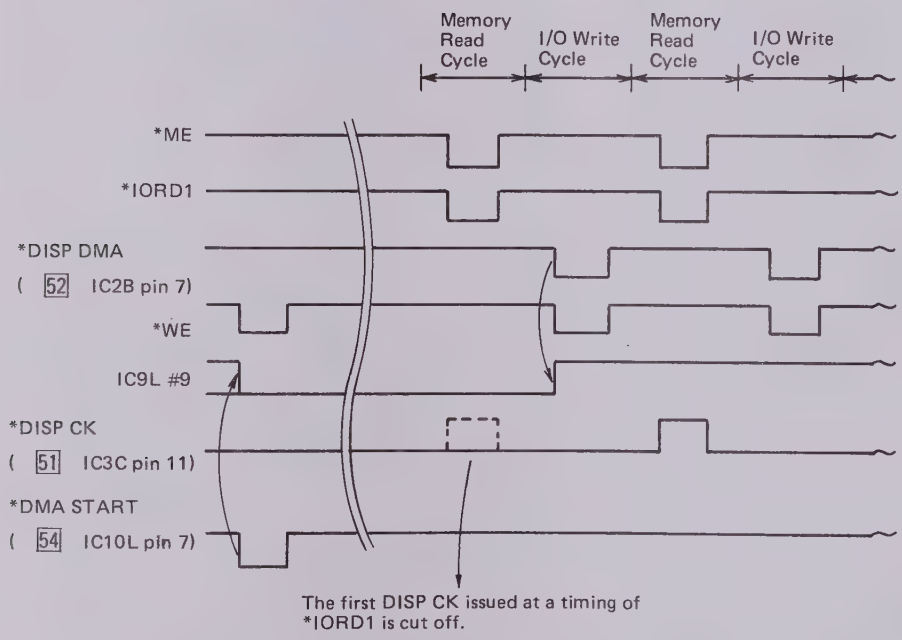
(80H equivalent to the CRT center in a vertical direction)

The IC7J is a buffer for reading in 80H data. It clears the memory at a high speed or gives basic data for sending 0 data to the lower byte when transferring data through the GP-IB.

(It is equivalent to 60000H through 7FFFFH in terms of memory space and can be considered as a ROM containing 80H data.)

Since the CPU incorporates the DMA controller, this is necessary when clearing a certain memory space with the DMA or when specifying the DMA mode in GP-IB data transfer.

Figure 2-2-22-1. Timing Chart



2-2-22 DMA Controller [51]

(DMA control in the GP-IB described later)

*DREQ0 Control

Using the DMA controller built in the CPU, this equipment communicates data between memories and between the memory and external I/O (DISPLAYS [30] and [31] , DM control [41]) at a high speed through the DMA.

For the DMA between the memory and external I/O, the IC9L pins 1, 2, 3, 4, 5 and 6 controlled by *DREQ0 are flip-flops which control *DREQ0.

When starting the DMA, [54] IC10L pin 7 *DMA-START is momentarily set to "L", passes through the IC9K pins 11, 12 and 13 and sets the IC9L pin 6 to "L". It then passes through the IC9J pins 8, 9, 10 and the IC9K pins 8, 9, 10 and sets CPU's *DREQ0 to "L" to start the DMA.

Upon completion of the DMA, a *TENDO signal is issued from the CPU. As a result, the IC9L filip-flops are cleared by a *DMASTOP signal via the [54] IC9J pins 4, 5, 6 and *DREQ0 is set to "H" again.

*DMA RESET, which is another factor to generates [54] IC9J pin 6 *DMA STOP, ([53] IC3L pin 7) is used when initializing the set.

DISP CK Generator [51]

In case of DMA transfer of waveform data, etc. to the DISPLAYS [30] , [31] , a clock is required, which causes the address counters on the DISPLAY side to count up. This circuit generates that clock.

As DMA operations, data is read from the CPU-side memory and writes it to the DISPLAY side.

Since a DISPLAY-side address is an initial one upon DMA start, DISP CK must not be generated until first data is written.

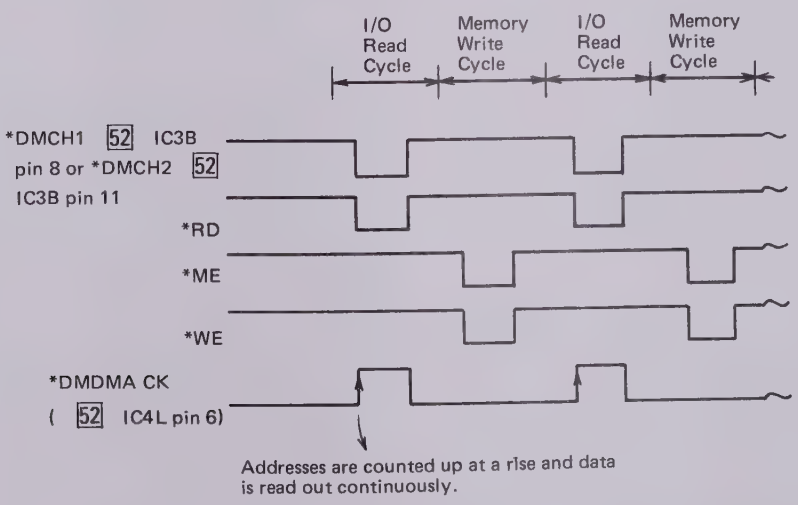
Therefore, there is a circuit provided, which erases the first clock.

In an initial condition, the IC9L pin 9 is at "L". A basic signal for DISP CK is $\overline{RD}$ from the CPU. A signal IORD1, whose polarity has been inverted at the IC4P (pins 13, 12), is controlled by the gate which consists of the IC3C (pins 11, 12, 13) and IC9L (pins 9, 10, 11, 12, 13).

DM DMA CK

In case of DMA for transferring waveform data from the DM control [41] to the CPU-side memory, the circuit mentioned above is not required because the first address on the DM control side is set after giving a clock. The following shows a timing chart.

Figure 2-2-22-2.



2-2-23 Status Latch Circuit and LED Lighting 52

The IC2J and IC2H produce set control signals in accordance with a setup condition.

*10M/20M: In the normal STORAGE mode, internally, the ADC 35 and DM controller 41 operates at 10 MHz sampling. However, when a sweep range exceeds 5 μs/div in the DS-6612, their operations are switched to 20 MHz sampling. (set to "H" at that time). Therefore, it is always at "L" for the DS-6411 (max. sampling 10 MHz)

*CH1 IN, *CH2 IN: Used for selecting the channel which passes ADC data to the DM control.

CHARA MASK: Masks an interrupt of *INTCHARAEND (described later).

Of the status latch signals, *REAL/STORAGE, *RUN/STOP, *REMOTE, *CUR/DLY, *C1, *C2 and *FINE also light up key LEDs. When these signals are set to "L", the LEDs are lit up. So, LED lighting is static one and not scanned.

2-2-24 Interrupt Circuit 52

CPU's external interrupts are INT0 through INT2.

INT1 is an interrupt from the GP-IB or RS-232C and is directly connected to the CPU.

The other interrupt factors are contained in the IC2F pins 2 through 7; the pins 2 through 4 are for INT0 and those 5 through 7 for INT2, and they are connected to the CPU by negative logic OR of the IC1E.

When the CPU enters an interrupt acknowledge cycle, an interrupt factor is latched to the IC2F by IC2B pin 11 *INTPOLLING, and at the same time, it is read into the CPU.

INT0 Interrupt Factors

(Interrupt when panel setting is changed)

*INT SSKEY (IC2F pin 2): Information on the rotary switch related to the synchroscope or lock type push sw (described later)

*INT DMKEY (IC2F pin 3): Information on the non-lock type key related to the DM (described later)

*INT ROTARY (IC2F pin 4): Information from the rotary encoder (described later)

INT2 Interrupt Factors

(Interrupt familiar with set internal operation timing)

* INT WRITEBUSY (IC2F pin 5): Set to "L" upon completion of latching a waveform. WTBY coming from the 41 IC4E pin 14 is a signal which is set to "H" when latching the waveform. This signal is inverted at the IC1C pins 13 and 12 and latched at the IC1D pins 1 through 6. This interrupt is cleared by 53 IC3L pin 13 *WTBYCLR. (so that it will not be cleared by processing with other interrupt factor)

*INT FRAMEEND: Set to "L" at a waveform display end timing. TRCEN coming from the 30 IC1G pin 8 is a signal which is set to "H" while a STORAGE waveform is displayed, and set to "L" while characters are displayed. (always "L" in the REAL mode)

This signal is inverted at the IC1C pins 3, 4 and latched at the IC1D pins 8 through 13. This interrupt is cleared by IC2B pin 11 *INTPOLLING simultaneously with interrupt servicing by the CPU.

*INT CHARAEND: Set to "L" at a character display end timing. The original signal TRCEN for the interrupt above is latched at the IC1F pins 1 through 6 as it is. This interrupt is masked and cleared depending on the status of IC2H pin 13 CHARAMASK of the status latch (perviously described). (in order to generate an interrupt when the CPU can accept)

The 3 interrupt factors for INT2 work as follows:

<Waveform Update Sequence in STORAGE Mode>

Start of waveform latching → *INTWRITEBUSY (waveform latching complete) → *WTBYCLR (interrupt clear) → Waveform data processing → CHARAMASK set to "H" → *INTCHARAEND (character display complete) → CHARAMASK set to "L" (interrupt clear) → Display waveform rewritten

In the STORAGE mode, characters are altered at a timing of *INTFRAMEEND. In the REAL mode, character alteration is updated at any time.

2-2-25 *INT DMKEY (DM Key Processor) 53

The DM keys (11 non-lock type switches located on the right side of the panel) are all processed by the IC3M (μPD8279C-5).

The 11 keys on the panel are located in a matrix shape by RL0 through RL5 and SL0, 1 (see the description for the keyboard 55).

The 8279 is used in the 2-key Lockout mode of the Scan Keyboard mode (decode scan).

Scan Keyboard mode (decode scan): This mode, which distinguishes the key pressed by scanning, sets SL0 through SL3 signals to "L" one after another, As SL (0-3) (scan line) and RL(0-7) (return line) come into contact with each other where the key switch is pressed, both SL and RL are set to "L". With their combination, it can be known which key was pressed. This equipment, however, uses SL0, SL1 and RL0 through RL5. SL pulse lengths are about 640 μs, respectively.

It takes about 2.5 ms to scan from SL0 to SL3 once. (A clock input to the 8279 is about 3 MHz.) A CPU clock is frequency-divided into two at the IC3E pins 1 through 6.) It is further frequency-divided into 30 inside the 8279. The 8279 operates with an internal clock of 100 kHz.)

Two-key Lockout: This mode assumes that no key was pressed when two or more keys were pressed simultaneously. Only when a single key is continuously pressed for 10 ms or more, key information is stored into the 8279.

When the information corresponding to the pressed key enters the 8279, the 8279 sets pin 4 IRQ to "H" and applies an interrupt to the CPU. (resulting in *INT DMKEY with a polarity inverted at the IC3K pins 10 and 11) The interrupt is cleared when the CPU attempts to read the key information.

The key information is temporarily stored in the RAM inside the 8279 (up to 8 information). Therefore, when the keys are pressed many times while the CPU is processing other task and does not accept an interrupt, the contents of up to 8 keys are stored. The interrupt is not downed unless the CPU reads all intermation.

2-2-26 *INT SSKEY (SS Key Processor) 53 (20 , 21)

The information on the SS keys (rotary and lock type switches related to the synchroscope) are transferred in a serial system, using the CPU's CS I/O (clock sync. serial I/O ports), and eight of CD026 (bidirectional serial/parallel convertion: IWATSU-made gate array) located in 20 and 21 . As 8-bit data is handled per CD026, the total number of data is 64 bits.

CD026

CD026 is a serial/parallel conversion IC. It allows a conversion from a serial input (OUT mode) to an 8-bit parallel output or from an 8-bit parallel input (IN mode) to a serial output, depending on the I/O SEL status of the pin 6.

Serial data is inputted from the pin 1 SDIN, shifted in synchronization with a SCLK clock (8-bit shift register incorporated) and outputted from the pin 15 DOUT.

Pin 13 *DLST wroks differently depending on the mode of CD026.

That is;

Serial input to parallel output (referred to as the OUT mode hereafter): Signal which latches internal serial data to a parallel output.

Parallel input to serial output (referred to as the IN mode hereafter): Latches parallel input terminal information to the internal shift register.

Pin 2 *DREQ is effective only in the IN mode. It is set to "L" when the parallel input status is changed. As *DREQ is of open drain output, wired OR can be connected.

REMOTE/LOCAL Selection

In the LOCAL mode SS key information is inputted in parallel to CD026 and transferred to the CPU as serial data (CD026 in the IN mode).

In the REMOTE mode, serial data from the CPU is outputted in parallel from CD026 (CD026 in the OUT mode).

Accordingly, in the REMOTE mode, it is necessary to separate the KEY SW from the parallel data line. The system shown in Figure 2-2-26-1. is used.

Since an inverter output is at "L" in the LOCAL mode, data is switched to L/H by turning the SW ON/OFF, whereas in the REMOTE mode, it follows output data from the CD026, because the open collector side is of high impedance.

For CD026, serial data is shifted through the internal shift register by SCLK. A shift timing differs depending on the IN/OUT mode (rise or fall of SCLK).

This equipment used 8 CD026s in 3 ways:

① IN mode ONLY, (SS KEY not remotely controllable): V-axis sensitivity, x 5, V-axis UNCAL, PROBE SENSE, CH2 POLARITY (20 IC01, 02)

② OUT mode ONLY (set with the rotary): DELAY TIME setting (21 IC06, 07)

③ IN/OUT mode selection (SS key not remotely controllable): Other SS keys (20 IC03, 21 IC03-05)

As described above, a shift timing for CD026 differs depending on a mode. So, when CD026s with different modes are connected, there will be a shift in serial data. Polarity inversion by SCLK is used in order to compensate that shift.

Figure 2-2-26-1.

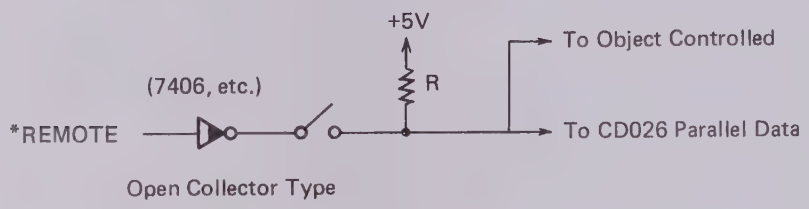
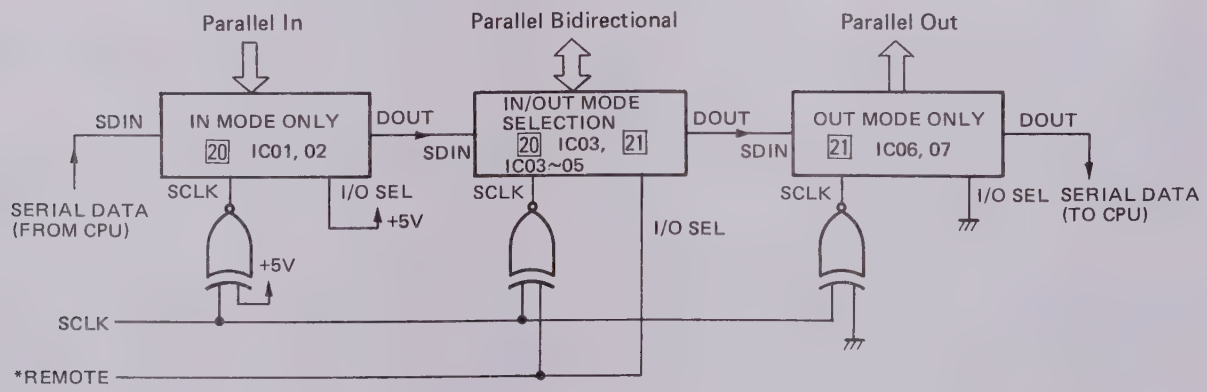


Figure 2-2-26-2.



CPU's CS I/O Ports

Clock sync. serial I/O ports for half-duplex 8-bit data communications.

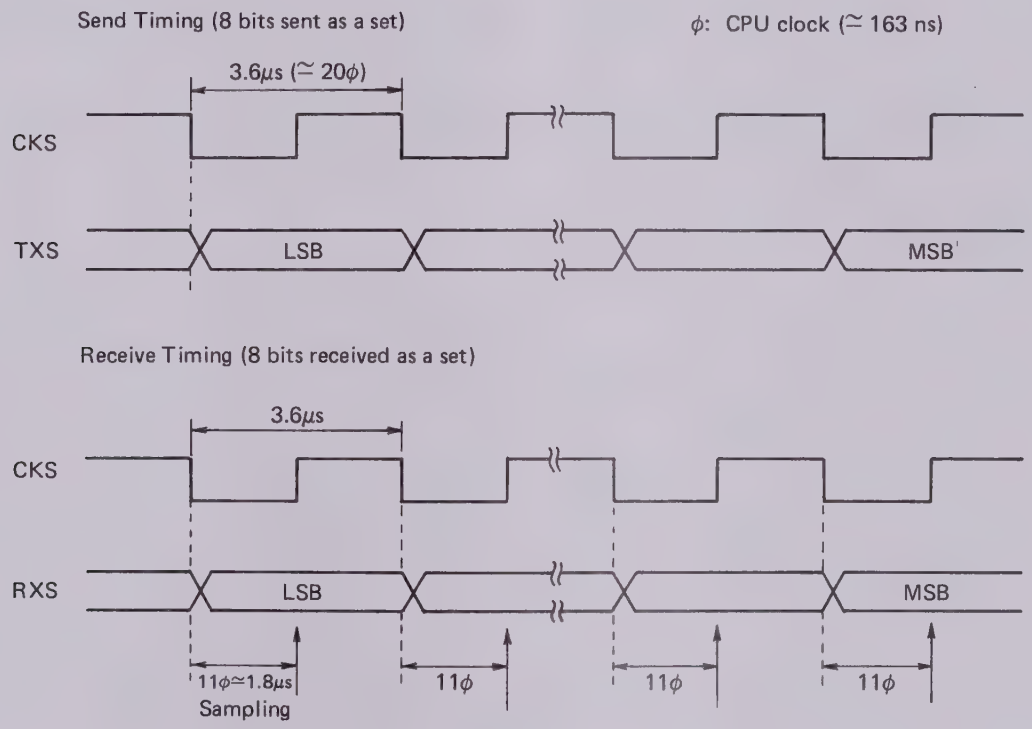
Set a baud rate to 2.8 x 10^5 BPS (1/20 of CPU CLOCK).

Pin 53 CKS of the CPU (51 IC8N) is a synchronizing clock . . . . . It results in CD026 SCLK.

Pin 52 RKS of the CPU (51 IC8N) is receive data. . . . . Connect to DOUT of CD026.

Pin 51 TXS of the CPU (51 IC8N) is send data. . . . . Connect to SDIN of CD026.

Figure 2-2-26-3



Operations When SS KEY is Changed in LOCAL Mode

Since *DREQ for the 8 CD026s, which reflect the SS KEY information, is wire-connected, if the SS key is changed in the LOCAL mode, J5302 pin 10 *DREQ is set to "L". As *DREQ for CD026s directly reflects a change of the inputs status, chattering is directly sent to *DREQ in case of mechanical SW.

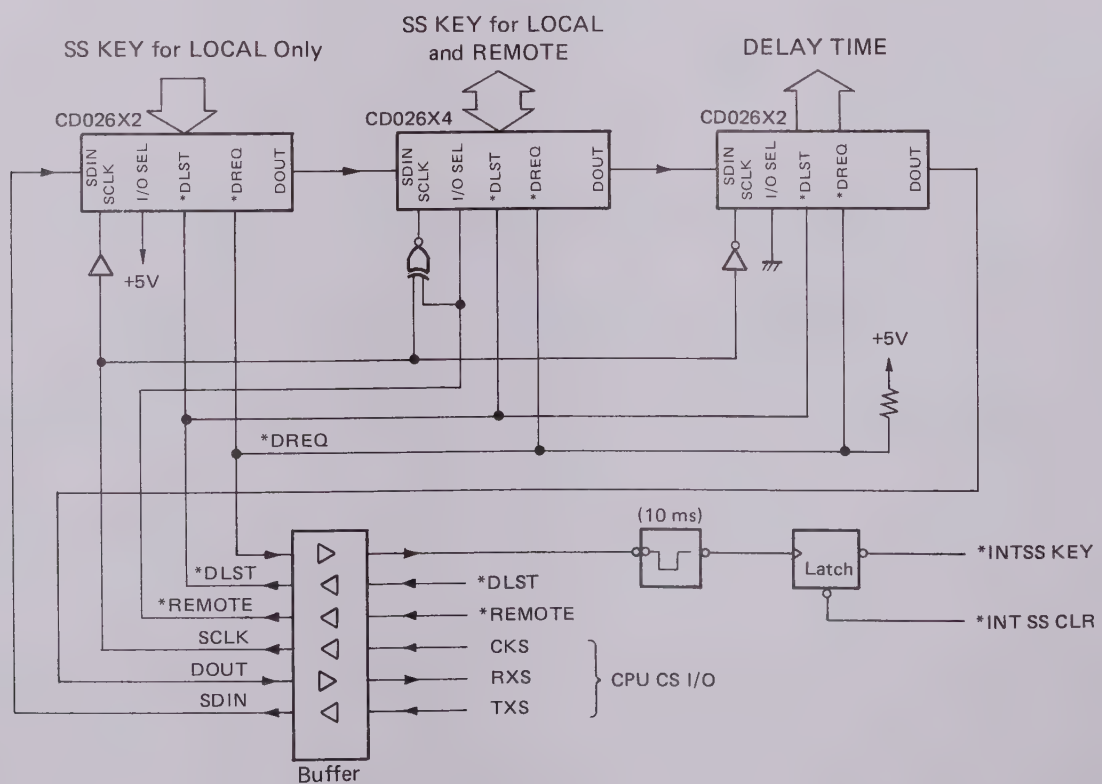
*DREQ, which passed through the IC3A pins 14, 13 and IC3J pins 5 and 6, is released from chattering by the monostable multivibrator of the IC2E pins 6, 7 and 9 through 12. A pulse length for this monostable multivibrator is set to about 10 ms. The D flip-flop of the IC3E pins 8 through 13 is hit by a rear edge of pulses produced here generate an interrupt of *INT SS KEY. When this interrupt is recognized by the CPU, it is cleared IC3L pin 11 *INT SS CLR.

Next, the CPU issues *DLST for the IC3L pin 15, *DLST is sent to CD026s in 20 and 21 from the J5302 pin 6 through the IC3H pins 4-6 and IC3A pins 4, 5. This signal causes the CD026s to latch the parallel input status (that is, SS KEY status) to the shift register inside the IC.

The CS I/O signal lines of the CPU, CKS, RXS and TXS are connected to the CD026s in 20 and 21 from J5302 via the IC3A, as SCLK, DOUT and SDIN, respectively.

After sending *DLST, the CPU receives data from eight CD026s to obrain the SS key information. (reception of CS I/O) Then, the CPU sends the SS KEY information received to the 8 CD026s as it is (sending of CS I/O) This is a preparatory operation for the CD026s to be switched from the IN mode (LOCAL) to the OUT mode (REMOTE). (because it is not known when switched to the REMOTE mode).

Figure 2-2-26-4. Block Diagram



Operation in REMOTE Mode

Pin 10 *REMOTE of the IC3A is set to "L", a half of the CD026s in [20] and [21] ([20] IC03, [21] IC01-03) are switched to the OUT mode from the J5302 pin 8, *DLST is sent from the CPU and the contents of the shift register inside the CD026 are parallelly outputted, thus resulting in the REMOTE mode. (For this reason, the CPU receives the SS KEY information, and then, sends the same information again as it is, in interrupt servicing of *INT SS KEY.)

When a change is made by a REMOTE command, the CPU sends 8 CD026s worth of data including unchanged key information. After sending, it outputs *DLST to complete a change.

Even in the REMOTE mode, there are CD026s ([20] IC01, IC02) with the IN mode (REMOTE unallowed SS keys, for example, V sensitivity, etc.) and the SS keys may be changed. In that case, *DREQ is generated and the CPU services the *INT SS KEY interrupt previously mentioned.

Delay Time Setting

A delay time is set by the OUT-mode-ONLY CD026s ([21] IC04, IC05). When these ICs are changed regardless of LOCAL/REMOTE, data is sent from the CPU.

2-2-27 Rotary Encoder Circuit Counter [53]

An output from the rotary encoder is a 2-phase (A and B) type. They are mutually deviated by half a period. This pulse is outputted in accordance with a rotation angle and an H/L level difference is regulated at 2 V or more.

A rotary encoder rotating direction is determined depending on which of the A and B phases precedes. Both A and B phases are waveform transformed at the IC2N (LN393) and enter X_A and X_B of the IC3N (μPD4701AC) Threshold values upon waveform transform are TH_H = 1.8V and THL = 1.3V.

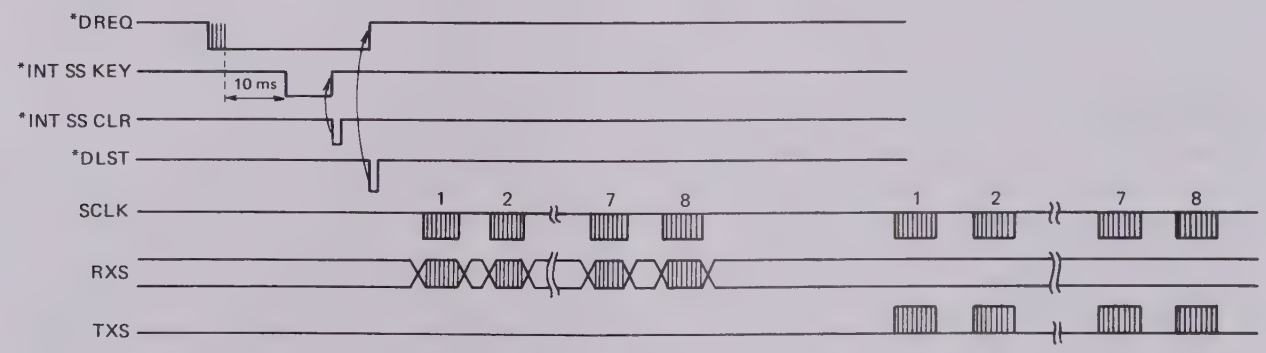
The μPD4701AC is an LSI for mouse used in personal computers, etc. It counts up or down a 2-phase pulse of such as a rotary encoder, etc., taking a rotating direction into account. Although 2 sets of 2-phase pulses can be counted, this equipment uses only 1 set (X_A, X_B are used, and Y_A and Y_B are unused).

An incorporated counter is 12 bits, and when a count ups or downs, $\overline{CF}$ is set to "L" and it applies an interrupt to the CPU.

When the CPU confirms the interrupt, it goes to read a count value to the 4701AC. If the count value is read, $\overline{CF}$ is automatically returned to "H".

In this equipment once the count value is read, IC3L pin 9 *ROTA RESET is issued to reset the count value of the 4701AC.

Figure 2-2-26-5. Timing Chart



2-2-28 Rotary Encoder Circuit Interrupt Controller 52

An interrupt signal $\overline{CF}$ from the rotary encoder passes through the IC2D pins 13, 11, as *INT ROTARY, to send an interrupt to the CPU. In order to prevent the CPU from being devoted to only its processing when the rotary encoder is kept rotating, the monostable multivibrator (IC2C pins 5-7 and 9-12) and the IC2D pins 11-13 privide controls so that the next interrupt does not enter for about 50 ms after an interrupt occurs once.

2-2-29 SINGLE RESET KEY Pressed Detector 53

J5302 Pin 16 RESET OUT is a signal which is set to "H" when the TRIG READY LED is turn on in the SINGLE mode.

A rise of RESET OUT pulse is latched by the D flip-flop of the IC1F pins 9-13 (IC2K pin 12 port is set to "H"). When switched from the STORAGE mode to the SINGLE mode, the CPU reads this port every 20 to 30 ms to grasp when a READY state is set up.

If TRIG enters and a WRITE state results, the D flip-flop is cleared and the port is set to "L".

2-2-30 SINGLE RESET PULSE, Generator 54

This circuit issues pulses to be sent to the real block when a RESET command comes in the Remote SINGLE mode.

The CPU issues IC2B pin 9 *SIN RST, activates the monostable multivibrator (IC2C pins 1-4 and 13-15) and generates from the pin 4 of the same IC negative logic pulses of about several ms. This signal is sent from the J5302 pin 14 to the real block.

2-2-31 GP-IB, RS-232C Parameter Setting 54

This equipment is assumed to set GP-IB's address and delimiter, or RS-232C's baud rate, bit length, parity, stop bit length and delimiter through the menu displayed on the CRT, without using the DIP SW. Set values are stored in the NVRAM (nonvolatile RAM) IC11J. The NVRAM is a nonvolatile RAM for which no battery is required. Therefore, the set values remain stored if the power of this equipment is turned off.

The NVRAM uses S-2210 (SEIKO-made) and has a 64-word x 4-bit (lower 4 bits of the data bus are applied) configuration. Internally, there are normal RAM area and nonvolatile area. A write to the nonvolatile area is not done by addressing; the contents of the RAM area are written as they are.

A write to the nonvolatile area is enabled by setting NVRAM's pin 9 $\overline{ST}$ to "L" for a certain specified time.

When the power is ON, the IC automatically reads data from the nonvolatile area to the RAM area.

Therefore, when parameter setting is changed, data is rewritten in the same manner as normal RAM, and thereafter, written to the nonvolatile area by issuing IC10L pin 13 *STORE.

When the power is ON, as an automatic read function is provided, a parameter read at initialize time, etc. is performed by only reading the RAM area; no other special operation is done. (pin 10 RC is not used)

2-2-32 GP-IB DMA Data Transfer Circuit 54

When this equipment is equipped with the GP-IB interface, the DMA can be used for high-speed data transfer. At that time, a data transfer format is a 2-byte (upper byte for real data, lower one for ϕ data) complment representation of 2 (80H for the CRT bottom, 00H for the center, 7FH for the top).

The internal data format of this equipment is 1-byte PURE BINARY (00H for the CRT bottom, 80H for the center, FFH for the top). In normal data transfer, data is converted with software to be sent and received. In DMA transfer, however, data is required to be converted with hardware because a direct transfer is done for the data in the memory.

Conversion from PURE BINARY to Complement Repsentation of 2

All you have to do is to simply invert MSB logic.

Upon data transfer in the DMA mode, the CPU issues IC10L pin 11 *GP-IB DMASET to preset the D flip-flop of the IC10M pins 1-6 (pins 8-13 are also preset at the same time).

Pin 6 *GP-IB DMA is set to "L" and sent as *GP-IB DMA from the J5401 pin 12 to the 58 GP-IB. An actual inversion of the MSB is done by the 58 GP-IB circuit, using the *GP-IB DMA signal.

Conversion from 1 Byte to 2 Bytes

A memory area, which contains actual data (for upper byte), and that, which contains 80H (for lower byte), are different, and therefore, they are alternately transferred using 2 DMAs.

As described above, when the IC10M is preset, the pin 5 is set to "H" and a signal enters the IC10N. At the same time, the MSB of the 51 IC7L is set to "H", thus preparing 80H, data for the GP-IB. The IC10M pins 8-13 are a flip-flop to switch 2 DMAs. At first, the pin 9 is set to "H" by preset.

As a data request from the 58 GP-IB, DREQ is set to "H" at the J5401 pin 8. (requested at "H") *DREQ1 and *GPDREQ0, which are DMA requests to the CPU, are alternately sent from the IC10N by alternately setting the IC10M pins 8 and 9 to "H" in response to this request.

*DREQ1 is the DMA for the upper byte, and *GPDREQ0 is that for the lower byte.

*IOE is contained in the IC10N in order to adjust a timing to detect DREQ from the 58 GP-IB to that for the CPU to detect *DREQ1 or *GPDREQ0.

The IC10M pins 8 and 9 are alternately switched to "H" at a rise of IC10L pin 10 *GP-IB DMADA of the GP-IB data transfer port.

2-2-33 Model Selection on Software 53

Model select ports are the IC2K pins 2, 4, 6 and 10.

(1) The pin 2 is for sensing an IC card model. In the DS-6612/-6411, it is always at "H". In case of the IC card model, a short plug is switched. Inserting (J6) into the upper side sets the pin 2 to "L", resulting in an IC card machine.

(2) The pin 4 is for sensing the DS-6612 and DS-6411. Inserting the J4 short plug into the bottom sets the pin 4 to "H", resulting in the DS-6612. Inserting the short plug into the top sets the pin 4 to "L", thus resulting in the DS-6411.

(3) The pins 6 and 10 distinguishes which of the GP-IB and RS-232C is mounted. These ports is connected to GND on the printed circuit boards of the 58 GP-IB and 59 RS-232C.

Therefore, when the GP-IB is mounted, the pin 10 is set to "L" (pin 6 to "H"), when the RS-232C is mounted, the pin 6 is set to "L" (pin 10 to "H"), and when neither is mounted, both pins 6 and 10 are set to "H". It never happens that both pins 6 and 10 are set to "L".

2-2-34 Others 54

Pen Recorder Output

The port used for the CPU to output data for the pen recorder is the IC10L pin 15 *DISP PEN.

2-2-35 GP-IB 58

The GP-IB interface is connected to the CPU data bus and assigned to the I/O port addresses 70H through 77H.

It consists of the buffer IC5804 to the CPU, interface controller IC5801 (μPD7210) and bus tranceivers IC5802, IC5803.

In addition, when outputting data at DMA transfer time, this circuit inverts D_7 of the data with the IC5808, 5807, 5805 and 5806, because it is necessary to convert from a pure binary into a complement of 2.

When inputting the data, the complement of 2 is converted into the pure binary, to the contrary. This is because the data format handled inside the DS-6612/-6411 is of pure binary. The IC5806, R5804 and C5802 is provided as a circuit to transform a DMA clock.

2-2-36 A/D [35]

The DS-6612 has 2 channels worth of 8-bit 20 MS/S ADCs. A circuit description is provided in the subsection on the CH1. Figure 2-2-36-1 shows an ADC block diagram.

A signal, which passed through the A/D buffer [6], is amplified, centering around 0V by the negative feedback type differential amplifier (preamplifier) of Q35101-Q35107 and led to the diode bridges D35104-D35107 of the S/H circuit. Then, it is held in the hold condenser by sampling pulses applied to the anodes of D35106, 35107 and the cathodes of D35104, 35105.

The held signal is amplified to 0-2V by the negative feedback type differential amplifier (buffer amplifier) Q35108-Q35115 similarly as in case of the preamplifier and inputted to the V_{IN} pin 21 of the ADC IC35102. Inputting a clock to the CK pin 18 of the ADC IC35102 A/D-converts an input signal and outputs data. This data is latched by the data latch IC35103 and outputted to the DM controller. A reference voltage for the ADC IC35102 should be a stable one; a voltage of +2V is obtained with the IC35101 and Q35181 and supplied to the REFIN pin 25.

Clocks include external, equivalent sampling and internal ones. One of them is selected by the clock selector IC35301. Since the clock outputted from the output pin 7 of the clock selector IC35301 is supplied to the S/H circuit, it is transform into 9 negative logic pulse with a pulse length of about 2 ns by the sampling pulse generator IC35310 and DL350. This pulse, after amplified by the S/H pulse amplifier of Q35116, Q35117 and Q35118, is divided into 2 pulses of positive and negative logic by the pulse transformer T35101, transform by the waveform transforming transformer T35102, and then, applied to the diode bridges.

The clock to be supplied to the ADC IC35103 is outputted from the pin 7 of the clock separator IC35301, delayed 40 ns by the delay line IC35312 and transformed into a negative logic pulse with a pulse length of about 35 ns by the pulse transforming circuit of IC35304, IC35311, IC35314 and IC35301.

The data latch clock, which is inputted to the CLOCK input pin 18 of the ADC IC102, is inverted 30 ns further later than the ADC clock and applied to the CLOCK input pin 11 of the data latch IC35103. The equivalent sampling clock and external clock are outputted via the IC35305, because they should be supplied to the DM controller.

Relations between the clock to be inputted to the ADC IC35102 and I/O data assume the timing shown in Figure 2-2-36-2.

The signal, which entered the V_{IN} pin 21 of the ADC IC35102, is A/D-converted at a fall edge of the clock inputted from the CLOCK input pin 18 and outputs data at a fall edge of the next clock. Up this output, the data is outputted with a delay of max. 18 ns from the fall edge.

In equivalent sampling, when a Write Start Enable signal enters from the DM controller, the counters IC35302 and IC35303 go into a count enabled state. As shown in Figure 2-2-36-3, a count value is D/A-converted by the D/A converter IC35307, enters the comparator IC35309 via the start/stop adjusting operation amplifier IC35308 to be compared with a sawtooth wave. First, the GATE signal sweep enables a flip-flop clock to be accepted, the sawtooth wave rises, and when a level matches, a comparator output is changed from the L level to the H level.

If this rise edge is inputted to CK of D-FF IC35305, Q output is set to "H". Upon completion of one sweep, the GATE signal is turned to "L' to set CLR of the D-FF IC35305 to "L". At this time, the Q output is set to "L". A signal generated by repeating this becomes the equivalent sampling clock and is directed to the clock selector IC35301 and the DM controller [41]. At a fall of this clock, the count values of the counters IC35302 and IC35303 are incremented and the next count values are outputted to the D/A converter.

When one screen worth (1,024) of data have been taken in by repeating this sequence 1,024 times, a series of equivalent sampling ends.

Since equivalent sampling requires a 60 MHz band, Q120 of the preamplifier is controlled (off) to extend an amplifier's band. For the external clock, it is transform by the external clock waveform transforming circuit of Q35301 and Q35302 and directed to the clock selector IC35301 and DM controller [41].

Figure 2-2-36-1

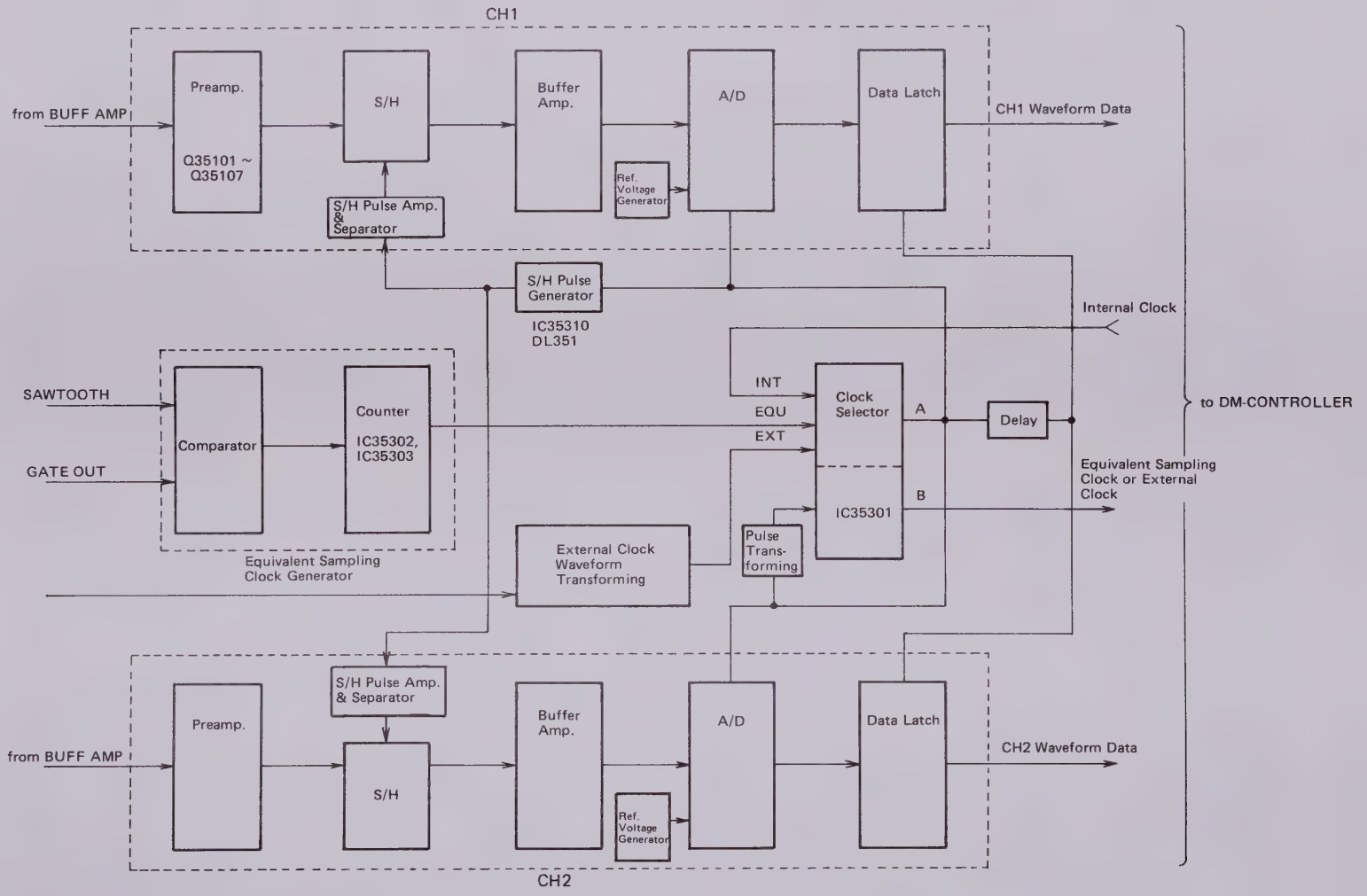


Figure 2-2-36-2. S/H and A/D Timings for DS-6612 20 MHz Sampling

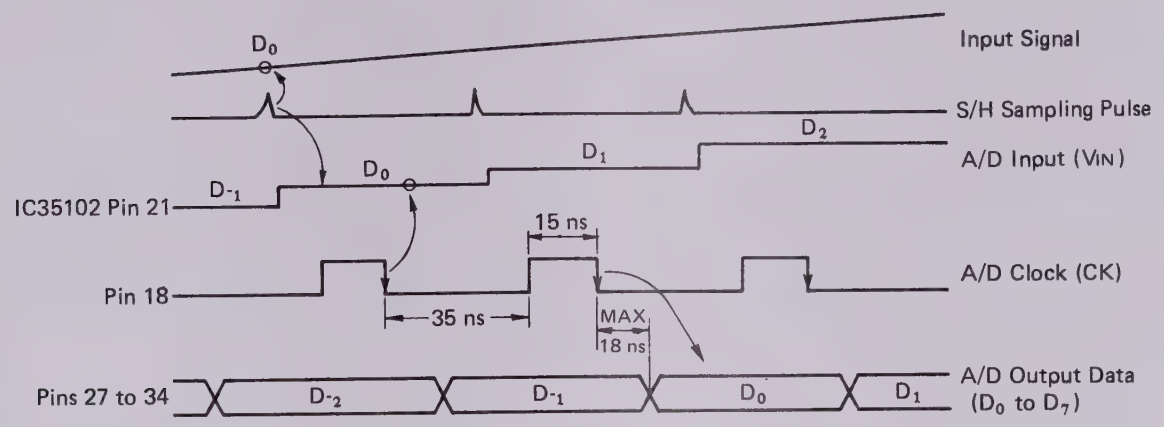
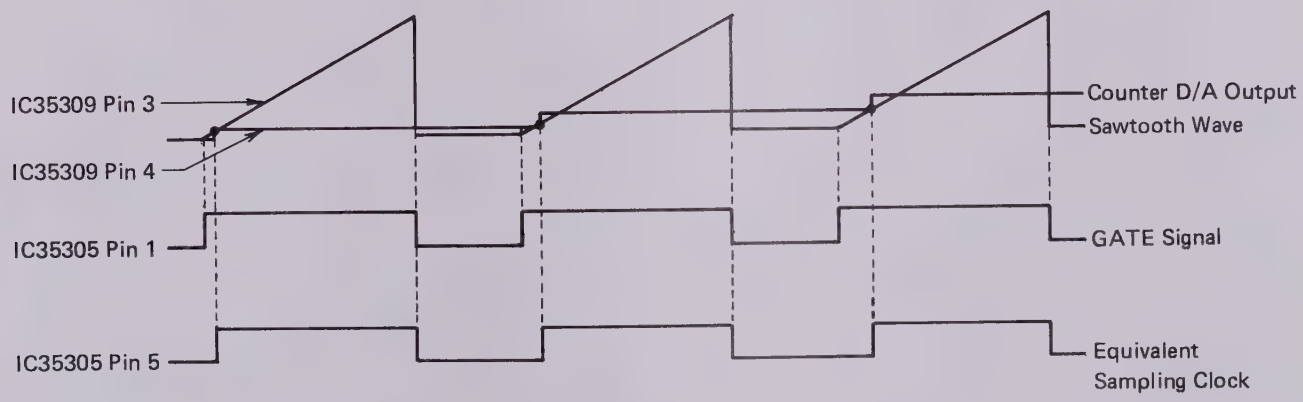


Figure 2-2-36-3. Equivalent Clock Generation Timings



2-2-37 A/D [36]

The DS-6411 has 2 channels worth of 8-bit 10 MS/S ADCs and consists of the blocks shown in Fig. 2-2-37-1. Its circuits are the same as the CH1 and CH2. The following description picks up the CH1 as an example.

A signal inputted from the A/D buffer is directly inputted (signal of 0 to 2 V) to VIN of the ADC IC36101 via the limitters D36101 and D36102.

In order to supply a reference voltage to the +REF input, the constant-voltage circuit is formed with the IC36102 and Q36101 to always apply a voltage of 2 V.

When a clock is inputted to CK of the ADC, the ADC IC36101 outputs data at the timing shown in Figure 2-2-37-2.

The data outputted is latched by the data latch IC36103 and directed to the DM controller.

There are two kinds of clocks for the ADC; internal and external clocks. They are selected by the clock selector IC36301. The internal clock is supplied from the DM controller [41] and inputted to the ADC IC36101 via the clock selector IC36301. A latch clock is obtained by inverting a clock inputted to the ADC.

The external clock, after transformed by the waveform transforming circuit Q36301, Q36302, passes through the 50 ns delay line IC36303 and clock selector IC36301 and is applied to the clock inputs of the ADC IC36101 and data latch IC36103, similarly as in case of the internal clock.

Figure 2-2-37-1.

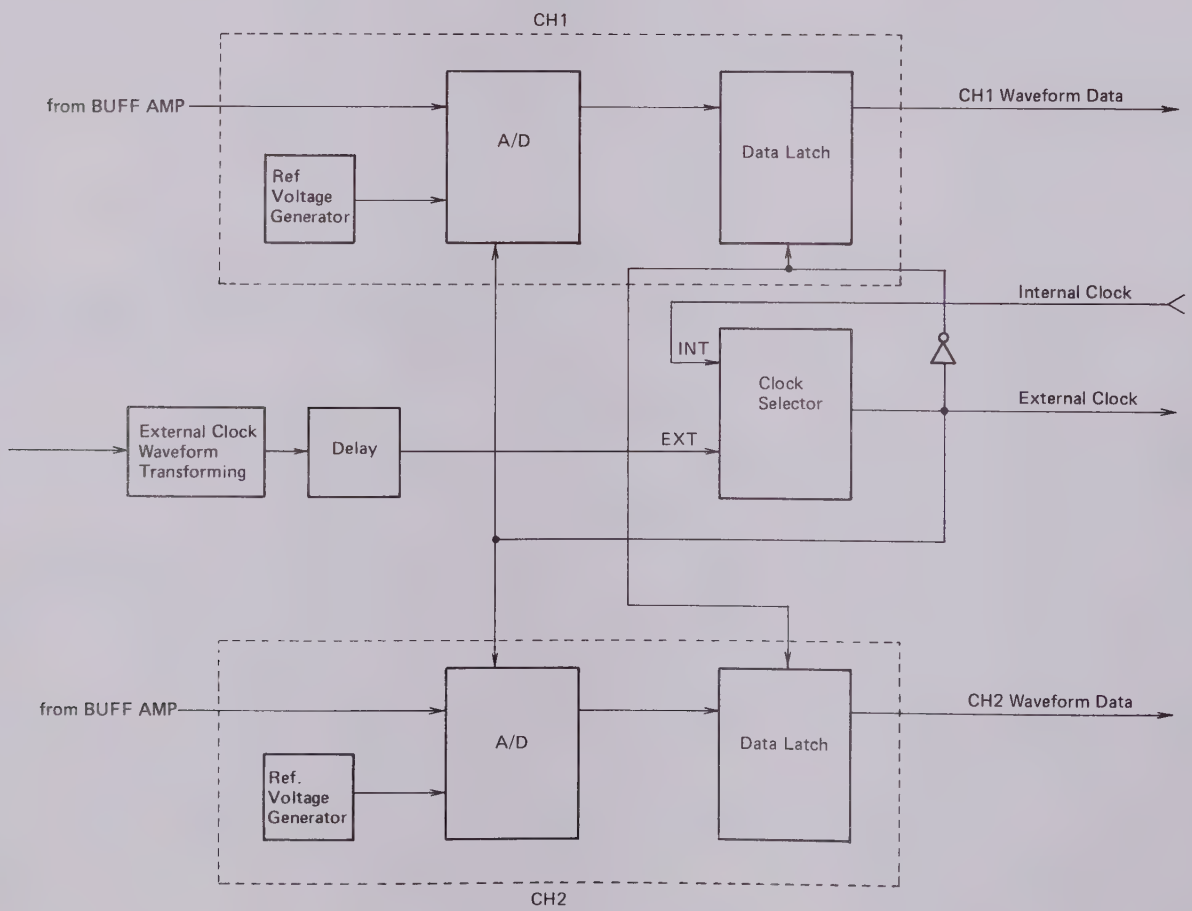
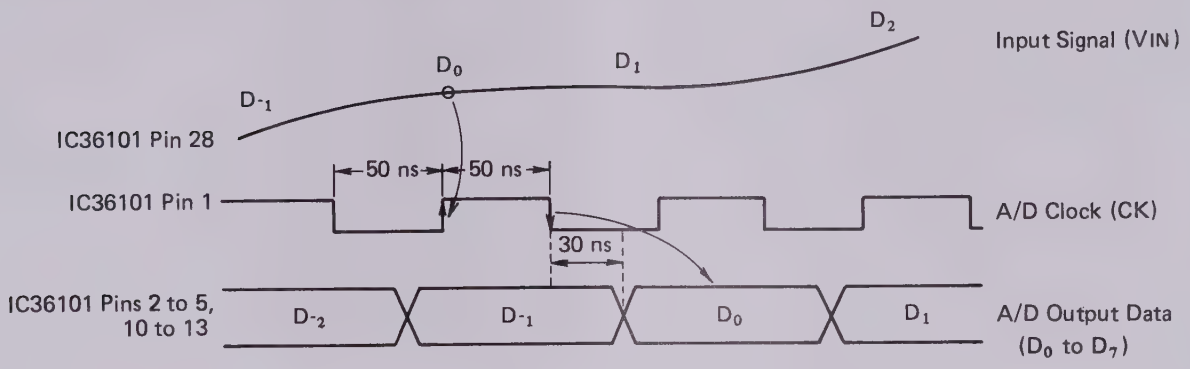


Figure 2-2-37-2. DS-6411 A/D Timings



2-2-38 DM Controller [41] (Digital Memory)

The DM controller controls latching A/D-converted data into the capture memory. This part is realized with our self-developed LSI.

The DS-6612 uses 20 MS/S specifications. When exceeding 5 μs/div (50 μs/div for 16 K), the 20 MHz operation mode results, and when coming lower than 10 μs/div (100 μs/div for 16 K), a 10 MHz operation mode results, switching the circuit. The DS-6411 uses 10 MS/S specifications and always operates in the 10 MHz operation mode. Figure 2-2-38-1 and Figure 2-2-38-2 shows signal line flow charts for the 10 MHz and 20 MHz operation modes.

In addition, the DS-6612 has the Roll mode, Equivalent Sampling and External Clock modes, and the DS-6411 has the Roll mode and External Clock modes. A capture memory capacity is 16 KB. Either 1 K or 16 K can be selected.

The DM controller consists of the blocks shown in Figure 2-2-38-3. In this controller, the DM-LSI IC410 serves as a main control unit to control the whole.

The DM-LSI IC410 is assigned to the I/O ports of the CPU and occupies 16-byte spaces from 50H. The DM-LSI IC410 can be operated by setting these ports with the CPU.

MAO through MA13 of the DM-LSI IC410 and the Q output of the IC6H becomes the addresses of the capture memories IC4111B, 4111C, 4111D, 4111E. However, as MAO through MA13 have different delay times when they are outputted, they are latched by the address latches IC418E, 419E, 416H to secure stable times, and then, become the addresses of the capture memories IC411B, 411C, 411D, 411E.

When a data length is 1 KB in the 20 MHz operation mode, the Q output of the IC416H results in Ao for the capture memories IC4111B, 4111C, 4111D, 4111E, and MAO to MA9 of the DM-LSI IC410 result in A_1 to A_{10}, respectively. When the data length is 16 KB, Ao results in the same as in case of 1KB, and MA_0 to MA_{12} in A_1 to A_{13}, respectively.

When the data length is 1 KB in the 10 MHz operation mode, MA_0 to MA_9 result in A_0 to A_9, respectively, and when it is 16 KB, MA_0 to MA_{13}, result in A_0 to A_{13} respectively.

The A/D latches IC419B and IC419C latch the data outputted from the ADCs [35] and [36], respectively, which clocks whose periods are in accordance with frequency dividing ratios.

The CPU buffers IC418D, IC419D are used when transferring to the CPU memory the data latched to the capture memories IC4111B, 4111C, 4111D, 4111E. They output data synchronously with the DMA clock of the CPU [52].

The display buffers IC418B, IC418C are used in the Roll mode for directly transferring data to the display memory [30]. A data output is controlled by a signal from the display controller.

A system clock to activate the controller directed to the clock selector, dividing the 40 MHz quartz oscillator X4101 into two with the frequency divider IC414B. This clock selector selects internal, equivalent sampling and external clocks.

The equivalent sampling clock and external clock are selected in the ADC circuit [35] and led to this controller. In the 10 MHz mode and Roll mode, the clock coming out of the clock selector is further divided into two by the clock frequency divider IC415D and enter the mode selectors IC4110F, 4110H, 4111H, 4109F. In other than these two modes, the clock directly enters the mode selectors.

The mode selectors IC4110F, 4110H, 4111H, 4109F select a write clock, read clock, system clock and latch clock in accordance with each of the 10 MHz, 20 MHz, Equivalent Sampling and External Clock modes and supplies them to the capture memories, circuits such as latches, etc.

These mode selectors are controlled by the decoders IC4111F. The decoder decodes a WTBY signal for the DM-LSI IC410 and *10/20 and *EXT EQU signals from the CPU. Its circuit is materialized by FPLA. Figure 2-2-38-4 shows the contents of the decoder, and Figure 2-2-38-5 shows output signals.

A signal from the pin 8(Z) of the mode selector IC419F becomes a reference clock to generate a latch clock for the A/D latches IC419B, IC419C, and a write pulse for the capture memories IC4111B, 4111C, 4111D, 4111E.

After passing through the timing control delay line IC7B used when writing A/D latch data into the capture memories, the write pulse enters the pulse transforming circuit IC415B, IC415C, IC416B and outputs a 25 ns negative logic write pulse. CS of the capture memories at this time is given a pulse at the same timing as the write pulse.

Different from the above in the Roll mode, a write clock and a chip select signal are generated by the Roll-mode write pulse transforming circuit IC414C at the timing shown in Figure 2-2-38-6.

Roll-mode operations are controlled from the display controller [30] , and a scan clock signal and a scan clock load signal are applied to NSCK and NSCL of the DM-LSI IC410.

When a write to the capture memories is caused by an applied scan clock, a DM-LSI's BLK (Blanking) signal is outputted to the display controller and Roll-mode write pulse transforming circuit.

The trigger synchronizing circuit IC415J synchronizes the GATE signal from the H-I/O [21] with the system clock of the DM controller. When the GATE signal comes in, an H-level signal is applied to TRGD of the DM-LSI IC410 and it is turned into a trigger signal.

The WTBY signal outputted from the DM-LSI IC410, which is turned to the "H" level during a write, is set to "L" when a write is completed.

Upon completion of a write, this signal is used as an interrupt to the CPU. It is also used as a signal to select the mode selectors IC4110F, 4110H, 4111H and 4109F, or to open and close the gate used for internally supplying a clock.

The WTBY signal outputted from the DM-LSI is used via the delay lines IC411A and IC416F. This is to adjust the timing when stopping the clock.

The input clock synchronizing circuit IC415D, 416C, 415F, 411K, 415C adjusts the timing when internally supplying the clock. It is designed so that the top clock will be input in a stable condition.

The A/D clock is supplied from this controller. A clock from the oscillator X4101 is frequency-divided into 10 MHz and 20 MHz clocks by the frequency divider IC4B. The clock suitable to the mode is selected by the IC415H and supplied to the ADC [35] or [36] through the timing control delay line IC414H. The timing control delay line controls the latch timings of the output latch of the ADC [35] or [36] and of the A/D latches IC419B, 419C of this controller.

The terminal of the DM-LSI IC410 used for this controller are described.

Figure 2-2-38-1.

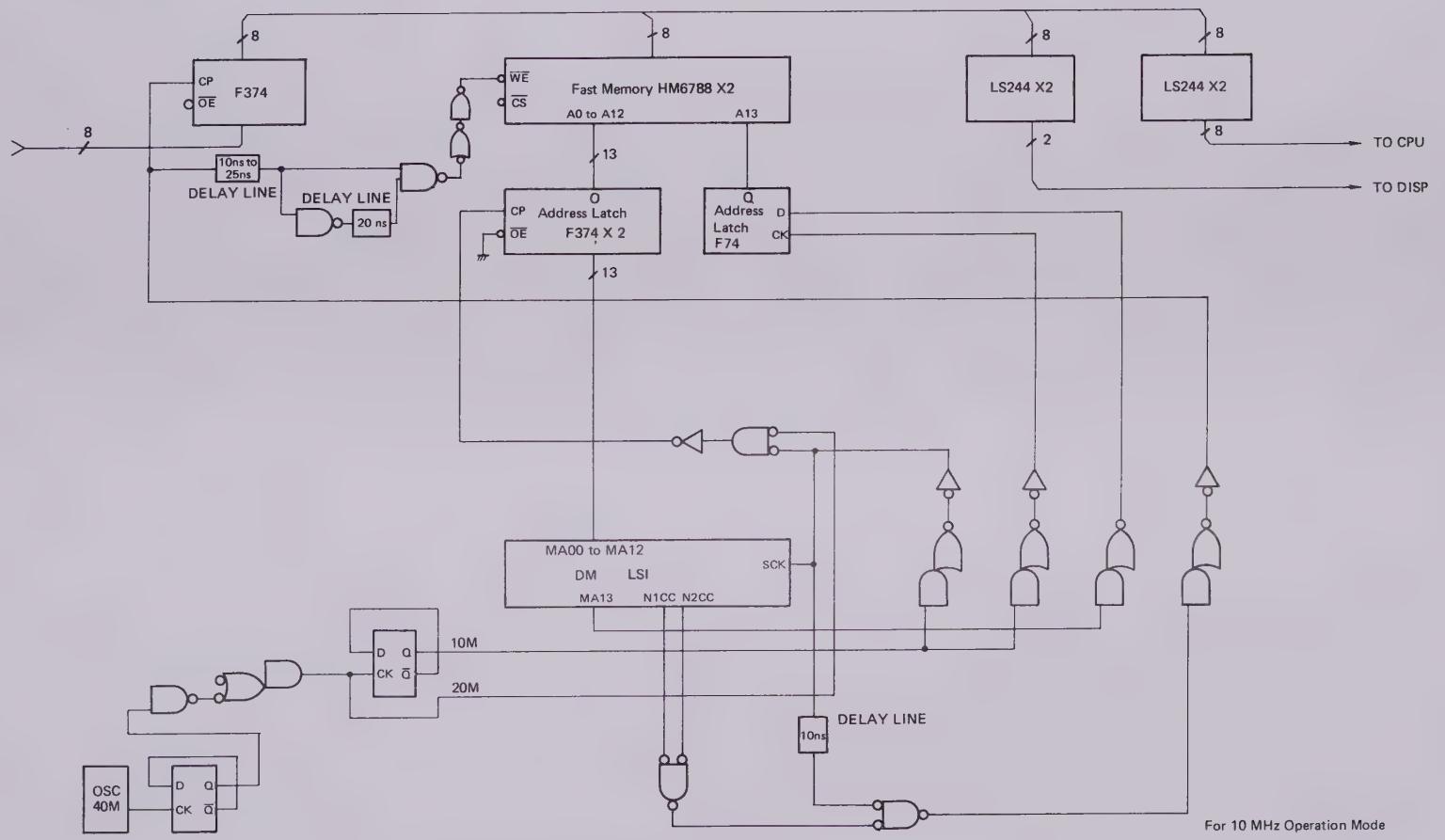


Figure 2-2-38-2.

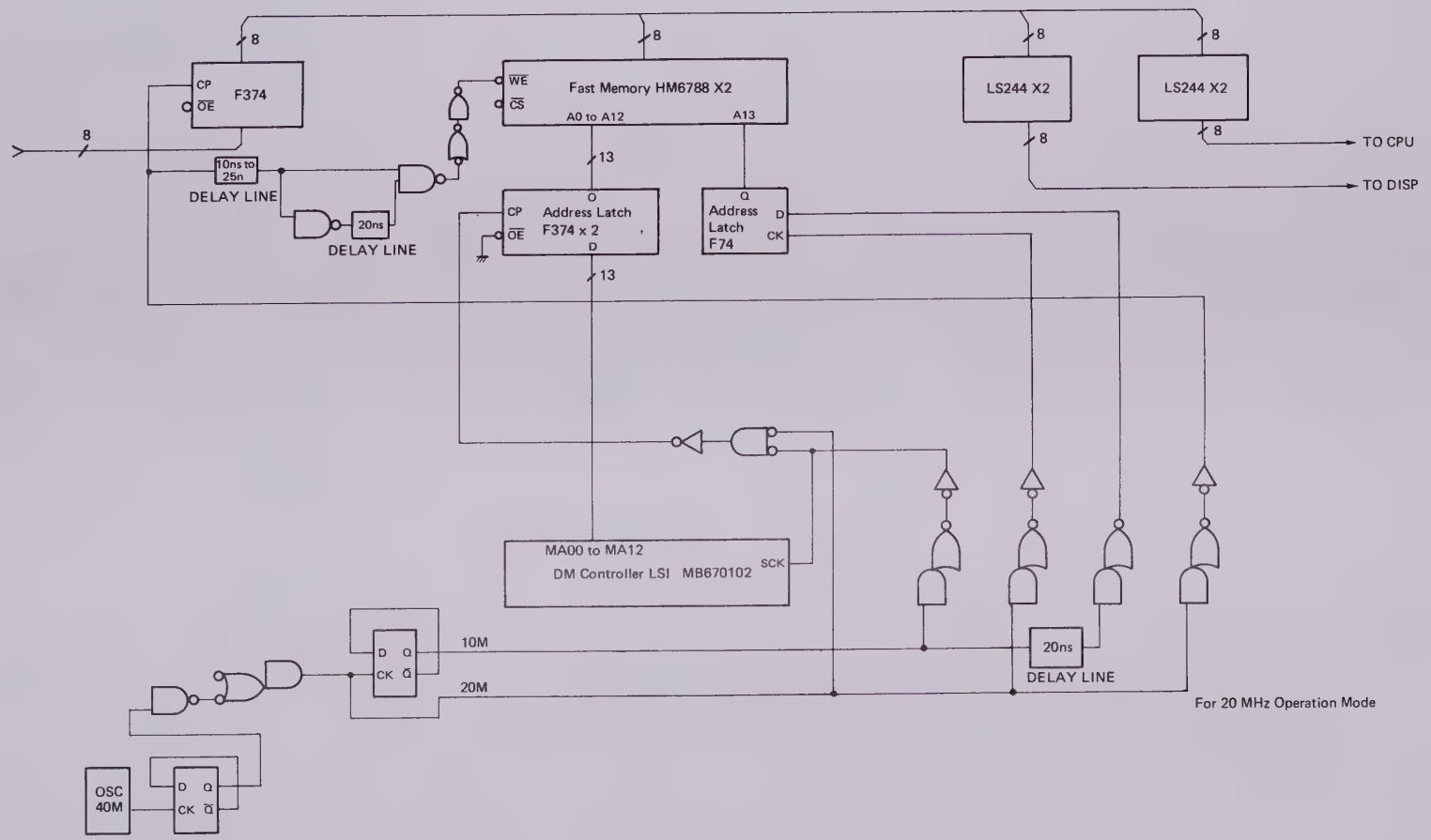


Figure 2-2-38-3.

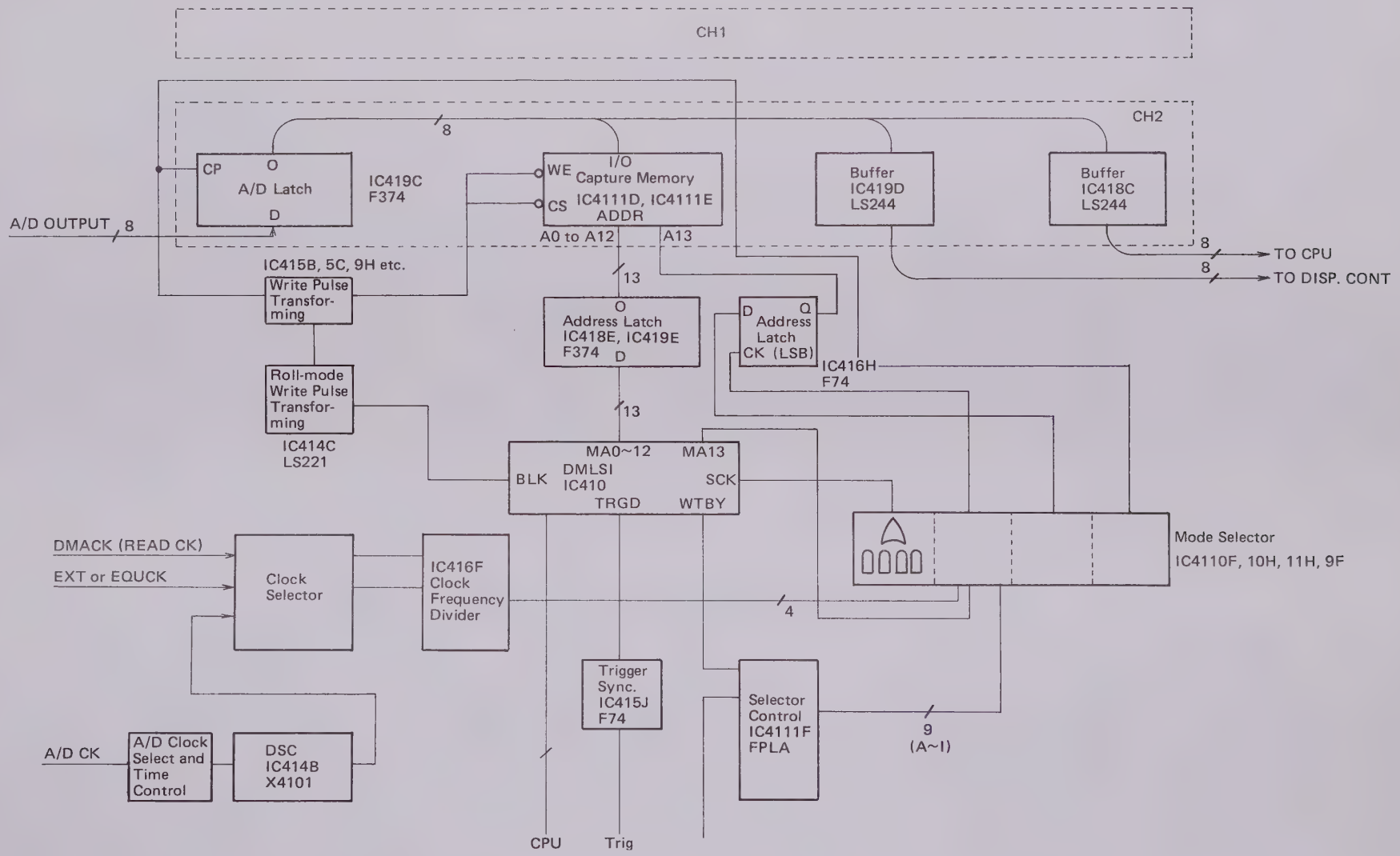


Figure 2-2-38-4.

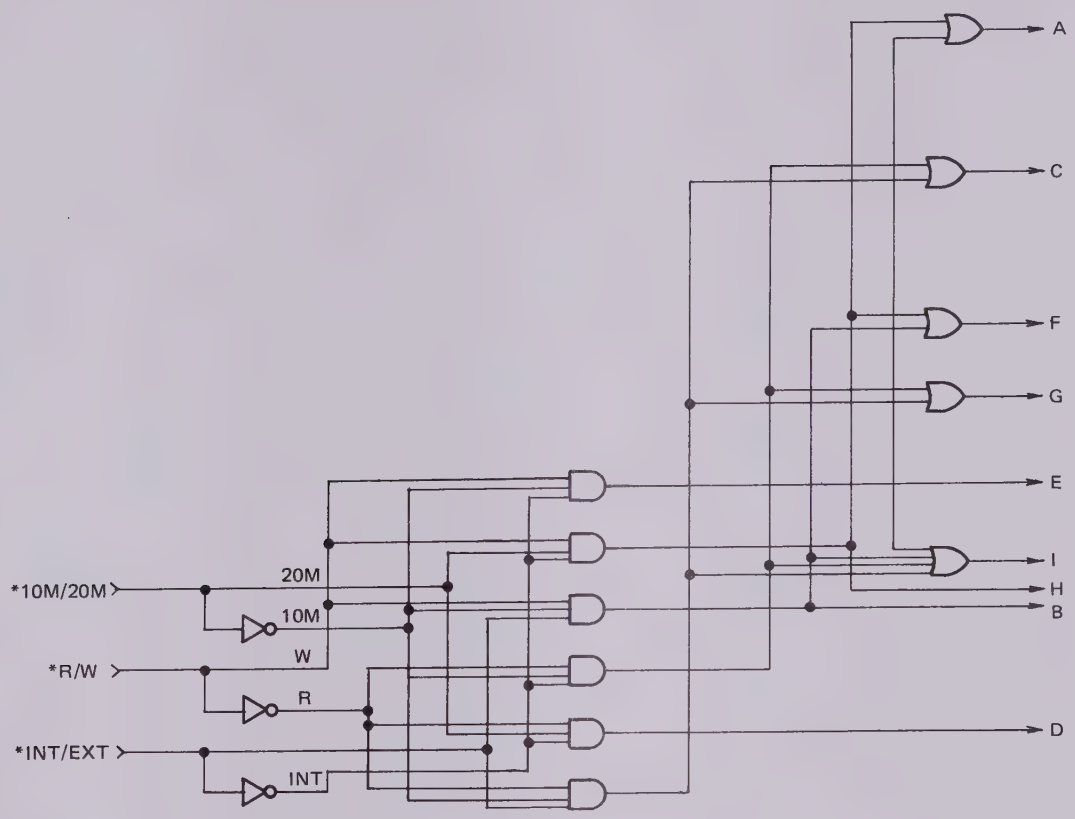
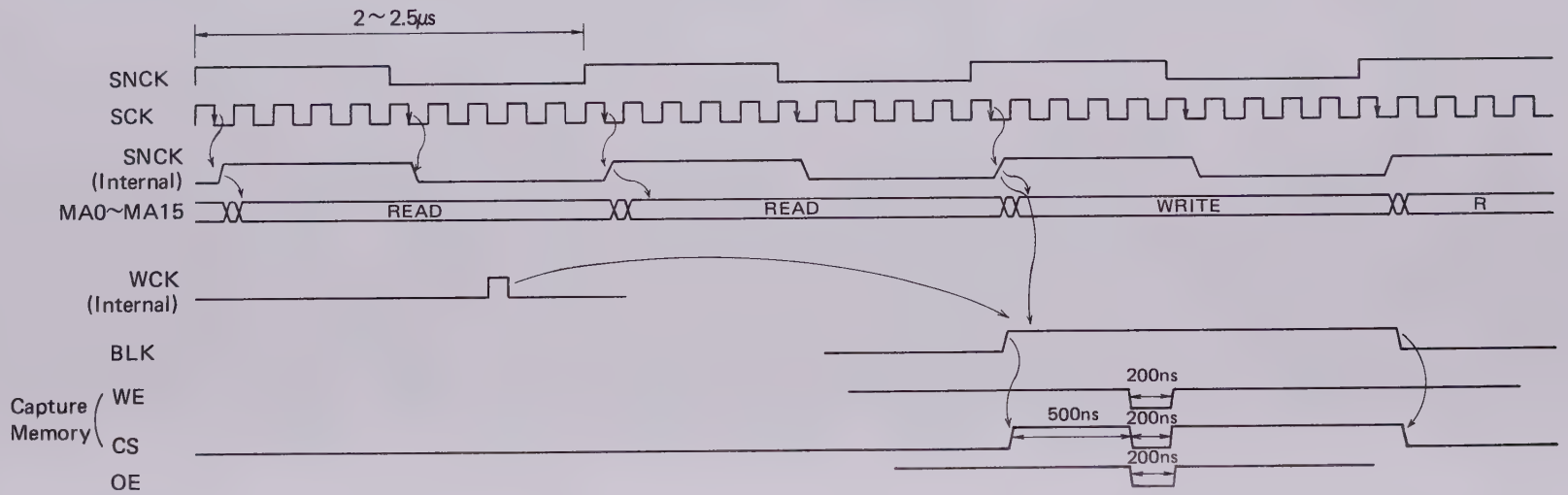


Figure 2-2-38-5. Mode Selector Outputs

DECODER INPUT			MODE SELECTOR OUTPUT			
IC4111F						
Pin 1 *READ/WRITE	Pin 2 *INT/EXT	Pin 3 *10M/20M	IC4110F Pin 8 W	IC4110H Pin 8 X	IC4111H Pin 8 Y	IC419F Pin 8 Z
WRITE (H)	*INT (L)	*10M (L)	10MHz CLOCK	10MHz CLOCK	MA13	Carry
WRITE (H)	*INT (L)	20M (H)	10MHz CLOCK	20MHz CLOCK	10MHz CLOCK	20MHz CLOCK
WRITE (H)	EXT (H)	*10M (L)	EXTERNAL CLOCK	EXTERNAL	MA13	EXTERNAL CLOCK
WRITE (H)	EXT (H)	20M (H)	—	—	—	—
*READ (L)	*INT (L)	*10M (L)	READ CLOCK	READ CLOCK	MA13	Carry
*READ (L)	*INT (L)	20M (H)	READ CLOCK/2	READ CLOCK	READ CLOCK/2	READ CLOCK
*READ (L)	EXT (H)	*10M (L)	READ CLOCK	READ CLOCK	MA13	Carry
*READ (L)	EXT (H)	20M (H)	—	—	—	—

Figure 2-2-38-6. Roll Mode Timings



2-2-39 Description of DM-LSI Terminals

- **DB0 to 7:** Bidirectional data bus, positive logic

  Data and commands are transferred to/from the CPU through this bidirectional data bus.

- **AB0 to 3:** Command/data control input, positive logic

  Control input which specified an LSI internal I/O address when controlling data/command transfer to/from the CPU.

- **NCS:** Chip select input, negative logic

  When this signal is at Logic "L", the I/O ports of this LSI can be activated.

- **NWR:** Write control input, negative logic

  When this signal is at Logic "L", a command or data can be written from the data bus.

- **NRD:** Read control input, negative logic

  When this signal is at Logic "L", an address counter value can be read from the data bus.

- **NRST:** Reset output, negative logic

  Logic "L" is output only when this LSI is reset by a command from the CPU.

  After reset, the address counter, delay counter, and scan counter in the Roll mode are cleared to 0.

- **SCK:** System clock input, positive logic

  Clock signal which serves as a basis for this LSI operations. All data write operations are performed synchronously with this signal.

- **WTST:** Write start flag output, positive logic

  A write start flag output is set to Logic "L" when this LSI is reset by a command, and it is set to Logic "H" when a start command is issued.

- **NTGI:** Trigger inhibit flag output, negative logic

  A trigger inhibit flag output is set to Logic "L" when this LSI is reset by a command, and it keeps outputting its logic while trigger acceptance is disabled. When trigger acceptance is enabled, Logic "H" is outputted.

  The trigger circuit external to this LSI must not accept a trigger while this NTGI's logic is at "L".

- **TRGD:** Trigger recognition input, positive logic

  Input signal to inform this LSI that the trigger circuit external to this LSI has accepted a trigger signal. The external trigger circuit inputs Logic "H" to this LSI after accepting a trigger.

  A timing to set this TRGD to Logic "H" must be after the NTGI signal of this LSI is set to Logic "H".

- **NPDL:** + Delay mode flag output, negative logic

  When this LSI is set to the +Delay mode by a command, NPDL outputs Logic "L". Logic "H" is outputted when set to the −Delay mode. (This controller operates in the +Delay mode only.)

- **N1CC:** First clock frequency divider carry output, negative logic

  Carry output of the first clock frequency divider (6-bits). It outputs Logic "L" with a width of one SCK period one time per the frequency dividing ratio set by a command. When the frequency dividing ratio is 1, Logic "L" is continuously outputted.

- **N2CC:** Second clock frequency divider carry output, negative logic

  Carry output of the second clock frequency divider which consists of 6 sets of decimal counters. Carry is outputted once per the frequency dividing ratio set by a command. The set frequency dividing ratio refers to a product of the first clock and second clock frequency dividing ratios.

  For a carry output width, outputted are a time width of the product of the frequency dividing ratio set with the first clock frequency dividing period and the time of the SCK period, and Logic "L".

- **WTBY:** Write status flag output, positive logic

  A write status flag output is set to Logic "H" when this LSI is reset by a command, and it keeps outputting that logic during a write action. Upon completion of a series of write actions, it is set to Logic "L". Logic "L" is also outputted when a write is forced to stop by a command during a write action.

- **MA00-15:** Acquisition memory address counter I/O

  MA00~05 . . . . . Bidirectional terminals positive logic

  MA00~09 . . . . . Output terminals, positive logic

  MA10~15 . . . . . Output terminals, negative logic

  MA00~15 are address counter outputs for accessing the data acquisition memory external to the LSI. Necessary terminals are sequentially used from the LSB side in accordance with a memory capacity externally connected.

When not in the Roll mode, a value of the 16-bit acquisition memory address counter external to this LSI is outputted. In this case, the counter counts up once per SCK (system clock) divided frequency in accordance with the system clock frequency dividing ratio specified by a command.

In the Roll mode, a value of the internal 16-bit scan counter of this LSI is generally outputted and the counter counts up with the clock signal NSCK for a scan clock input.

In this state, if a clock enters the acquisition memory address counter and its value is updated, a value of this counter is outputted for one scan clock period of the second scan clock subsequently generated, and thereafter, a scan counter value is outputted again.

When this LSI is reset by a command, both the data acquisition memory address counter and scan counter are reset. For the outputs of MA00 to 15, therefore, MA00 to 09 are Logic "L", and MA10 to 15 are Logic "H".

○ **BLK:** Blank output, positive logic

A blank output is a signal used when the Data Write mode is in the Roll mode. When the data memory is being scanned in the Roll mode, Logic "L" is outputted. When a write clock signal occurs and one scan clock period of scanning is used for data writing, however, Logic "H" is outputted.

In this case, this Logic "H" output is used as part of a Z-axis signal for the display circuit to blank (erase) the data being scanned on display.

In the normal Write mode other than the Roll mode, Logic "L" is continuously outputted.

○ **SNCK:** Scan clock input, positive logic

SNCK is a scan clock signal used when the Data Write mode is in the Roll mode.

This signal must have the same period as the clock signal of the X-axis sawtooth wave generating D/A drive counter of the unit which uses this LSI.

○ **NSCL:** Scan counter load input, Negative logic

NSCL is a signal used when the Data Write mode is in the Roll mode. If this signal is set to Logic "L", the value of the acquisition memory address counter is loaded onto the scan counter, after timing adjustment inside the LSI.

Loading to the scan counter must be done at a fall of the clock signal before one scan clock indicating the address 0 on the CRT display by the X-axis sawtooth wave generating D/A drive counter of the unit which uses this LSI. Since the scan clock (SNCK) inputted to this LSI is synchronized with the negative logic system clock signal internal to this LSI, NSCL must be generated at a timing with this taken into account.

○ **NEAC:** External address counter clock input, negative logic

NEAC is an acquisition memory address counter clock signal.

○ **NEDC:** External trigger delay counter clock input, negative logic

NEDC is originally an external trigger delay counter clock input. This controller uses this as a signal to stop a carry output by setting this input to "L" in the Roll Mode.

2-2-40 Display Controller

The display controller displays characters in the REAL mode at real time, and a waveform and characters in the STORAGE mode. The display controller largely consists of 4 blocks; a CPU interface, waveform display circuit, character cursor generator and output D/A converter.

Figure 2-2-40-1.

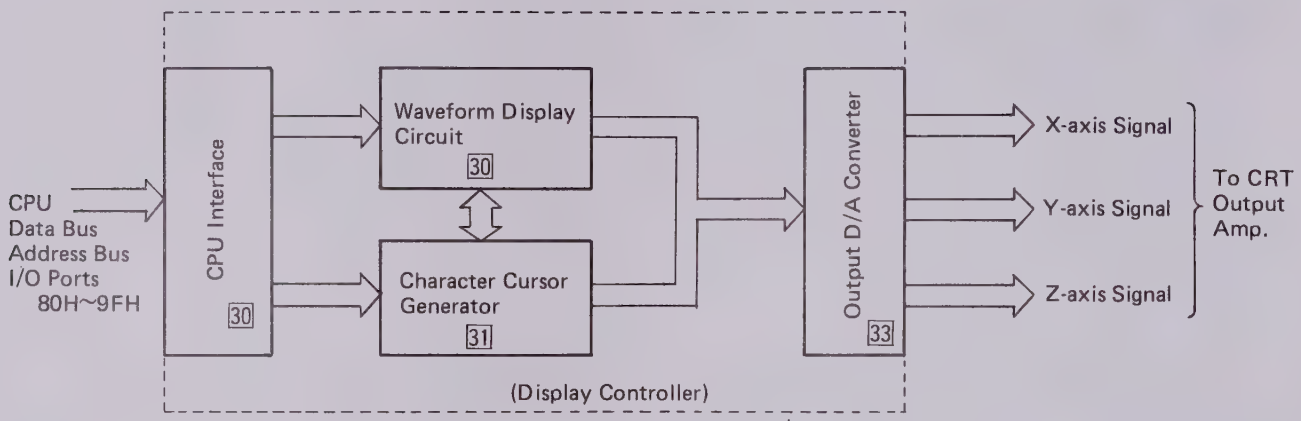
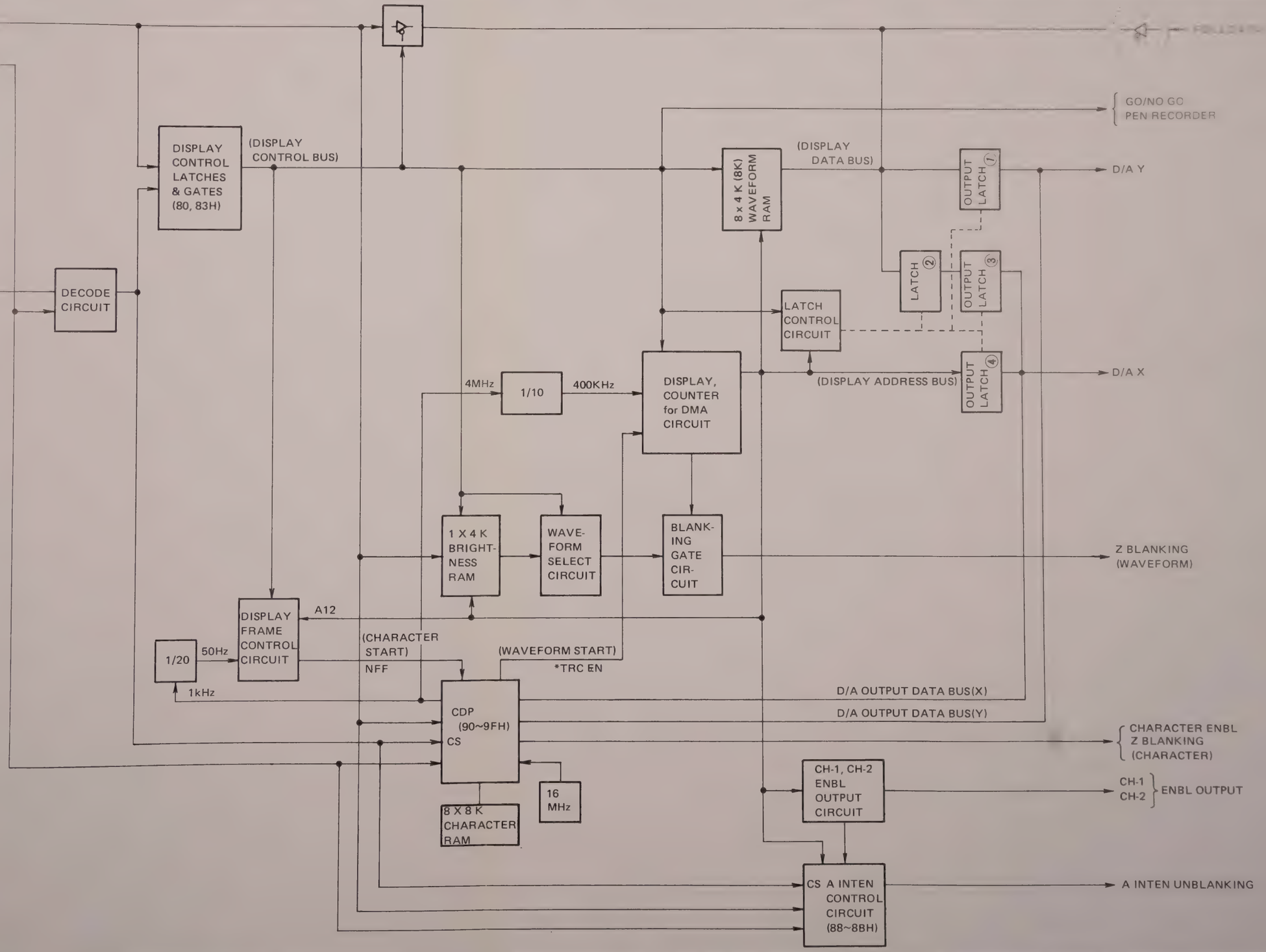


Figure 2-2-40-2. Display Control Circuit Block



DISPLAY CONTROL (80, 83H)

80H 1/ϕ

D7	———	
6	ROLL	ON / OFF
5	XY	ON / OFF
4	DMA	ON / OFF
3 2 1 0	DISPLAY CH SELECT OR DMA SELECT	

83H 1/ϕ

D7	GO / NO	ON / OFF
6	GO / NO SYNC	/OUTPUT
5	GO / NO NO	/OUTPUT
4	PEN	UP / DOWN
3	PEN RECORDER	ON / OFF
2	CHARACTER & WAVEFORM DISPLAY/CHARACTER DISPLAY ONLY	
1	———	
0	REAL/STORAGE	

2-2-41 CPU Interface [30]

This block transfers various data written to the CPU I/O ports 67H, 80H to 9FH to the waveform display circuit and character generator. Particularly, waveform and intensity data are transferred from the I/O port 67H by DMA.

2-2-42 Waveform Display Circuit [30]

This block outputs X-axis, Y-axis and Z-axis digital data for displaying storage waveforms (CH-1, CH-2, REF1, REF2).

2-2-43 Character Cursor Generator [31]

This block outputs X-axis, Y-axis and Z-axis digital data for displaying the character cursors (vector scan method). This circuit is operated by a dedicated LSI (character display processor abbreviated as CDP).

2-2-44 Output D/A Converter [33]

This block converts digital data on the outputted waveforms, character cursors into analog data and sends them to the CRT output amplifier (X, Y and Z axes).

Character Cursor Display in REAL Mode

In the REAL mode, characters are displayed with a method (vector scan method) in which they are displayed at necessary positions at any time while a realtime signal waveform is displayed.

A display time required for one screen worth (1 frame) of character cursors is about 20 ms. In accordance with the total number of character cursors displayed, the CPU performs a computation to change display dot spacing and sets CDP operations.

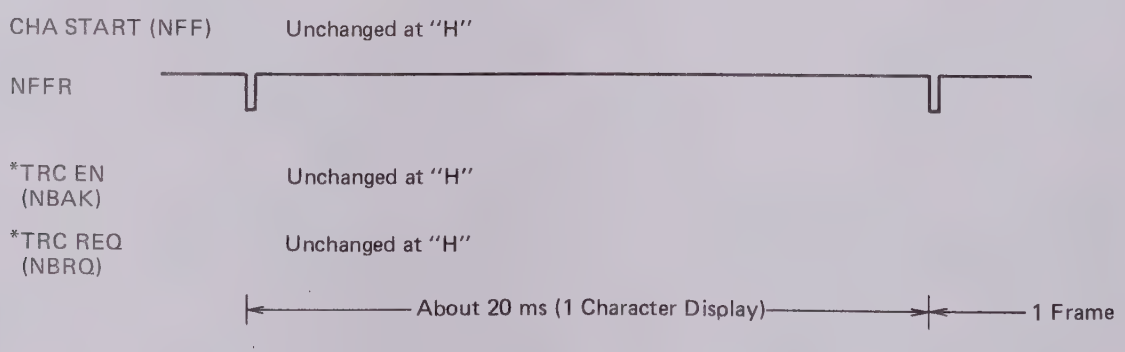
In short, the character cursor display circuit is self-running at about 50 Hz. The waveform display circuit is being halted. Figure 2-2-44-1 shows a timing chart for major signals.

REAL mode

The CDP itself is made freely run at about 50 Hz. (The waveform display circuit is halted.)

A free-running cycle is computed with software and set with the CDP register so that it will remain almost constant (about 20 ms), even if the total number of display characters is changed.

Figure 2-2-44-1. Waveform and character Display Timings I (REAL mode)



There is no pause period or waveform display period as in the STORAGE mode.

Waveform and Character Cursor Display in STORAGE Mode

In the STORAGE mode, a display of character cursors, waveforms (4 of them) and pause period is repeated in that order. Therefore, one screen worth (1 frame) of time is constant as 20 ms. (When there are many characters displayed, however, there is no pause period and 1 frame may exceed 20 ms.)

For the waveform, four waveforms worth of data are always outputted in the order of CH-1, CH-2, REF1 and REF2. Whether there is a display is controlled by a Z blanking signal (Figure 2-2-44-2).

STRAGE mode

A 50 Hz signal, which was obtained by frequency-dividing 1 kHz from the CDP, is used as a character display start signal. This mode repeats the following sequence.

Character display → Waveform Display → Pause → Character display

Figure 2-2-44-2. Waveform and Character Display Timings II (STORAGE mode)

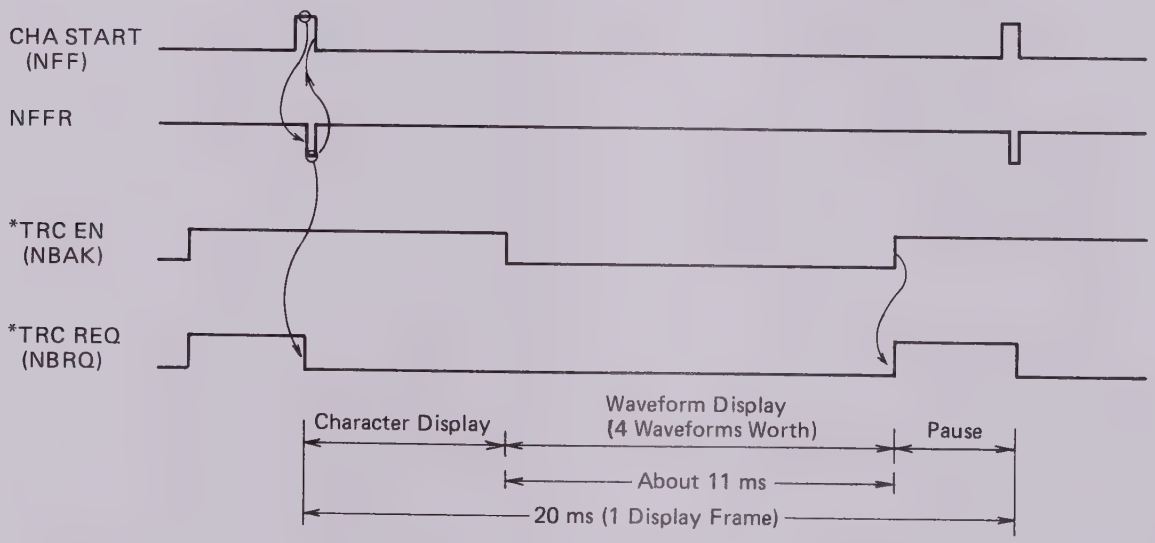
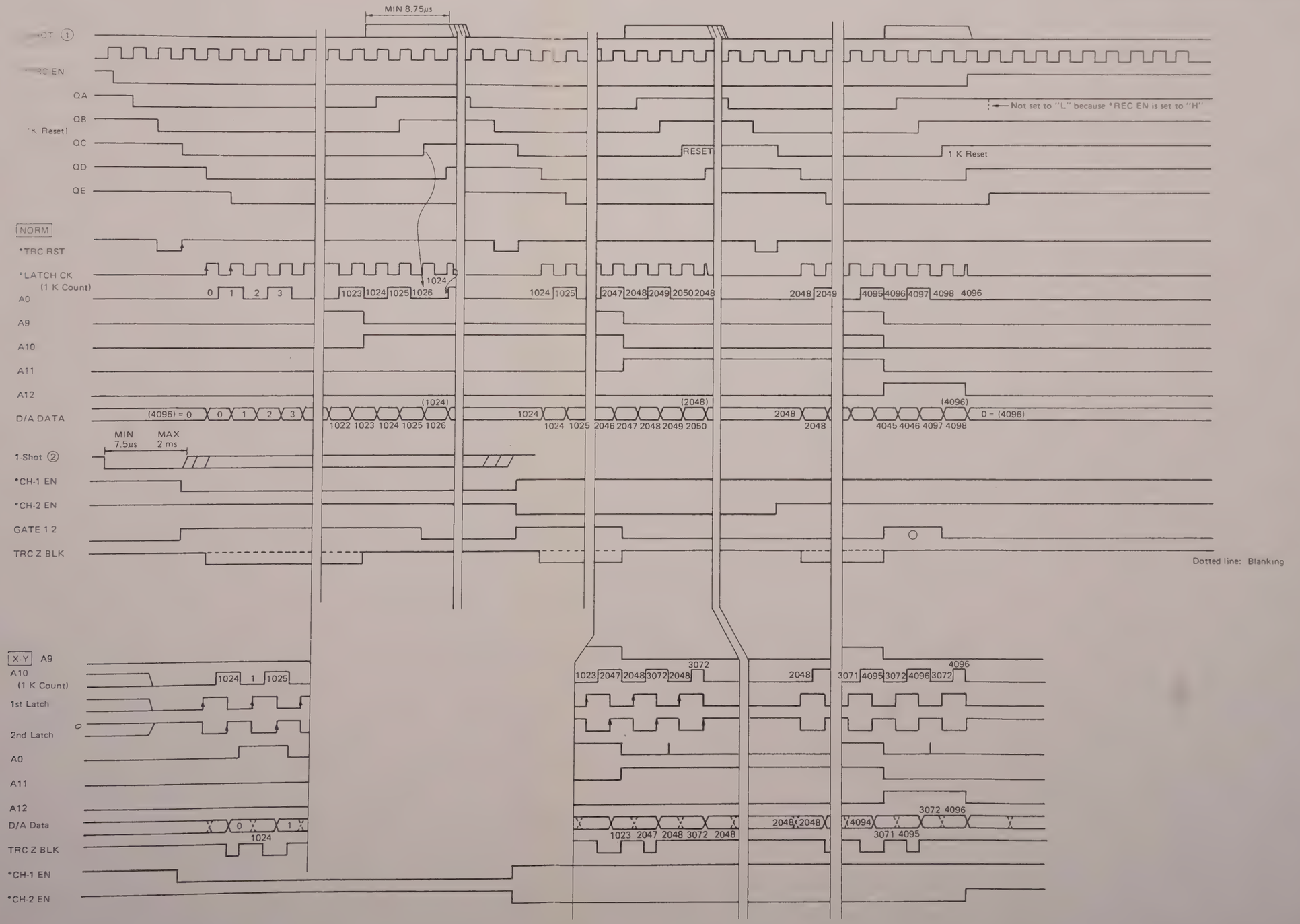


Figure 2-2-44-3. Timing Chart of STORAGE Waveforms Display



Details of Display Control Circuit Block

Controls from the CPU to the display control circuit are provided through the following I/O ports. The decoder circuit (IC3F) selects elements corresponding to each of the ports and causes data to be written. That data operates the display control circuit.

I/O Ports	Function	Corresponding Elements
80H, 83H	Display control	IC3B, 3C
88H~8BH	A INTEN brightness modulation control in the STORAGE mode	IC3H
90H~9FH	CDP (Character Display Processor) control	IC4H
67H	Waveform, brightness data, DMA transfer port	IC4C, 3E

2-2-45 CDP Block 31

The CDP (IC4H) externally has the 8-bit x 8 K RAM (IC6J) commonly used as a character font data storage and a video RAM and outputs X-axis (12-bit) and Y-axis (12-bit) data for character display Z blanking signal, etc. Also, the CDP divides a 16 MHz reference oscillation signal to output 4 MHz and 1 kHz signals and uses 400 kHz and 50 Hz, which are obtained by frequency-dividing (IC1M, 2H-1) those signals, as basic clocks for waveform display and character display start signal (NFF), respectively.

2-2-46 Counter Circuit Block [30]

The counter circuits (IC1D, 1K, 1F-1, 1H, 2A, 2D, 2E, etc.) for waveform display and DMA start counting a 400 kHz signal by means of a waveform start signal (*TRC.EN) and cause the waveform RAM (IC4C) and brightness RAM (IC3E) data to be read as display addresses. This count output is also used as an output for X-axis sawtooth wave generation at non-X-Y display time.

A waveform display count has a hold-off (pause) period of about 20 μs (IC1D-1, 1K, etc.) per waveform (1K count). When 4 waveforms worth of 4K count ends, an A12 signal output (positive pulse of about 8 μs) is applied to the display frame control circuits (IC2J-1, 2H-2, 1B-4, etc.), thus terminating a waveform display period (about 11 ms).

The signal (TRC EN) during a waveform display period is sent to the CPU circuit as a INT FRAME END signal. After a waveform display is completed, the display frame control circuits wait for a 50 Hz signal and outputs the character display start signal (NFF).

This counter circuit counts *DMA CK as an address counter for DMA transfer for waveform and brightness data sent from the CPU memory to the display memory. This DMA transfer is performed by setting the DMA mode per waveform (1K count) to the display control latches (IC3C, 2A, etc.).

2-2-47 Output Latch Block [30]

In normal display, the data read from the waveform RAM by the display address counter and a display address counter value are simultaneously latched to the output latches ① (IC3G) and ④ (IC6C, 4B) by the latch control circuits (IC1J, 1A, 1F-2, 2K-2, 2L-1) and outputted to the D/A bus.

In X-Y display, among the data read from the waveform RAM by the display address counter, the 1st data is latched to the latch ② (IC3D) by the 1st clock outputted from the latch control circuit, 2nd data to the latch ① by the 2nd clock, and at the same time, the 1st data is latched to the latch ③ (IC5C) and outputted to the D/A bus.

In short, the data read from the waveform RAM is sequentially latched to the output latches ① and ③ distributively and outputted to the D/A bus.

At Roll Display Time

An output from the waveform RAM goes into Hi-Z. Output data from the DM control side (DM CPU PCB board) synchronized with the display address counter and the display address counter value are simultaneously latched to the latches ① and ③ and outputted to the D/A bus. However, REF1 and REF2 waveforms are normally displayed.

At Pen Recorder Output Time

An output from the waveform RAM goes into Hi-Z. Data sent from the CPU data bus is sent to the output latch through the buffer (IC3L). A set of X and Y coordinate data (8 bits each) to be transferred are simultaneously latched to the latches ③ and ① and outputted to the D/A bus in a similar way as in case of X-Y display.

CH-1, CH-2 ENBL Output Circuit Block

Based on a signal outputted from the counter circuit block, the IC2J-2, 2F, 2L-3 and 2L-4 respectively output negative logic enable pulses at CH-1 waveform display time and CH-2 waveform display time. This signal is used for the ROLL mode control and STORAGE POSITION control of the DM controller.

2-2-48 A INTEN Control Circuit Block [31]

This is a negative logic pulse generator (IC3H, 1G-3, 2G-1, 2G-3) to apply brightness modulation of the A INTEN block to CH-1 and CH-2 waveforms at STORAGE time. The signal above can be obtained by setting the start point and length (time) of the brightness modulator to the timer IC.

2-2-49 Brightness RAM Circuit [30]

Which one of 4 waveforms is to be displayed depends on setting to the display control circuits (IC3C, 2B). When displaying with a display length at 1 KB or less, it is realized by this circuit (IC3E). A value "1" is written in a no-display address and "0" in a display address.

2-2-50 Output D/A Circuit [33]

X-axis and Y-axis 12-bit digital data outputted onto the D/A data bus are converted into analog signals by the DA converters (IC01, 02). Since both character cursors and waveform data are connected to the identical DA converter, the DA output gain select circuit (Q01, 05, etc.) and position shift circuit (Q03, etc.) work to correct differences in CRT display full scales and positions between them.

A simple integrating circuit (R29, C07, Q04, R35, C15, Q15, etc.) is installed in order to connect with bright lines between data when outputting a waveform signal. Furthermore, a circuit (Q07, Q08, etc.) is added for correcting a brightness difference of the connected trace.

A pen recorder signal and a GO/NO GO signal are switched by the analog switch (IC03) and outputted to the BNC connector on the back.

Section 3 Maintenance

This section describes the maintenance procedures for keeping the DS-6612/DS-6411 in good condition over a long period of time. If it becomes necessary to check and replace the circuit parts, refer to the Circuit Arrangement Diagrams.

Apart from the instruction given in this section, the proper operation procedures described in the operating manuals must also be observed to assure long satisfactory operation.

3-1 PREVENTIVE MAINTENANCE

These are the preventive maintenance procedure for preventing troubles and keeping your oscilloscope clean and well for a long period of time.

3-1-1 Cleaning

The extent of dirt varies according to the ambient condition in which the instrument is used. The instrument should be cleaned as required. Dirt accumulated in the instrument causes overheating because it interrupts effective heat dissipation. It also damages the parts under high-humidity condition. A dirty switch contact or connector can cause faulty contact, and dirt accumulated on the inner circuit part can cause spark during the wet season.

Exterior

Loose dust on the outside of the instrument can be removed with a soft cloth or small soft-bristle brush. The brush is particularly useful for dislodging dirt on and around the controls and connectors. Dirt that remains can be removed with a soft cloth dampened in a mild detergent-and-water solution. Do not use abrasive cleaners.

Interior

The best way of cleaning the dirt accumulated in the instrument is to use an air compressor. Dirt which remains after blowing with air compressor can be removed by using a soft paint brush and blowing again with air compressor.

CRT and Filter

The CRT screen and the filter can become dirty if they are used for a long time. Ordinary strains and fingerprints can be removed by wiping with a soft cloth. If they are terribly dirty, use a soft cloth dampened in a mild detergent-and-water solution.

3-1-2 If Unused for a Long Time

If you don't use the instrument for a long time, remove the probe, adaptor, etc. From it and put them in the supplied bag. Attach the supplied panel cover to it, put the dust cover on the oscilloscope, and store it in a place as dry as possible.

This can keep the instrument clean.

3-1-3 Checking

Inspect the inside of the instrument periodically for burnt resistors, faulty contacts, or damaged printed circuit boards. Major troubles can be prevented by repairing them immediately.

3-1-4 Periodic Adjustment

Periodic inspection and adjustments are necessary for keeping the instrument in accurate operating condition at all times. If the instrument is continuously used, inspect and adjust it about every 1000 hours. If it is not used so much, it may be inspected and adjusted about every six months.

3-1-5 Maintenance Aids

The maintenance aids listed in Table 3-1-5 include items required for performing most of the maintenance procedures in the instrument.

Table 3-1-5. Maintenance

Description	Specification	Usage
Soldering iron	15 to 40W	General soldering and unsoldering.
Nutdrivers	2.6 mm, 3 mm, 4 mm, 5 mm	Assembly and disassembly.
Adjustable angle wrenches	4 inches	Assembly and disassembly.
Long-nose pliers		Component removal and replacement.
Vacuum solder extractor	No static charge retention.	Unsoldering static sensitive devices and components on boards.
Spray cleaner	No-noise	Switch cleaning.
IC-removal tool		Removing DIP IC packages.

3-2 REMOVAL AND REPLACEMENT INSTRUCTIONS

The exploded view drawing in the "Section 7 Mechanical Parts List and Illustrations" of this manual may be helpful during the removal and reinstallation of individual components or subassemblies.

CAUTION

To avoid electric shock, disconnect the instrument from the ac power source before removing or replacing any component or assembly.

3-2-1 Cover Removal

The covers must be removed before inspecting the inside or replacing faulty parts.

a. Rear Panel

1. Remove two screws (see Figure 3-2-1-1).
2. Pull off the rear panel from the instrument.

b. Top Cover

1. Remove eight screws (see Figure 3-2-1-2).
2. Slide the cover slightly to rearward.
3. Widen on both edges of the cover and gently pull up it (see to NOTE).

c. Bottom Cover

1. Remove four screws (see Figure 3-2-1-3).
2. Lift the bottom cover.

NOTE

When removing or attaching the top cover, widen on both edges of the cover as shown in the figure below.

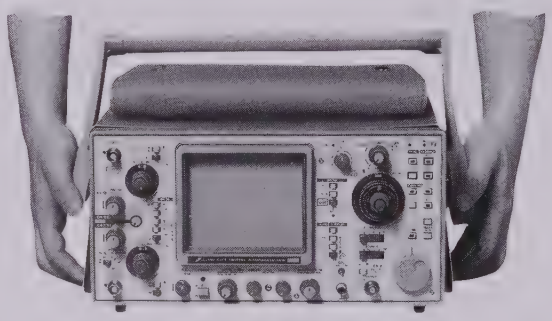


Figure 3-2-1-1. Screw Locations on Rear Panel

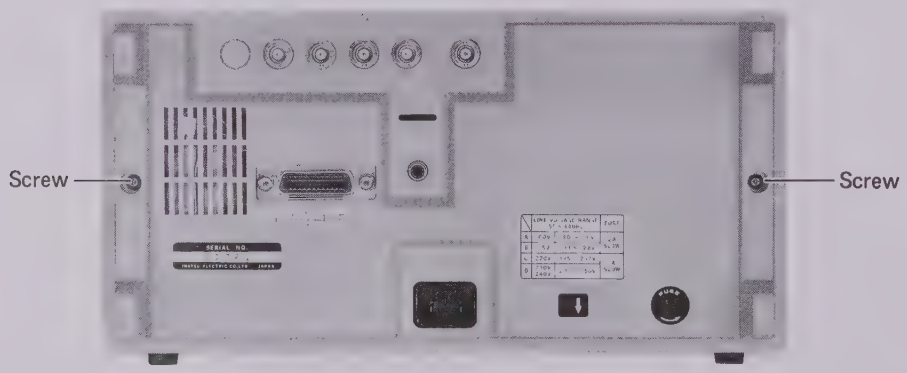


Figure 3-2-1-2. Screw Locations on Top and Side

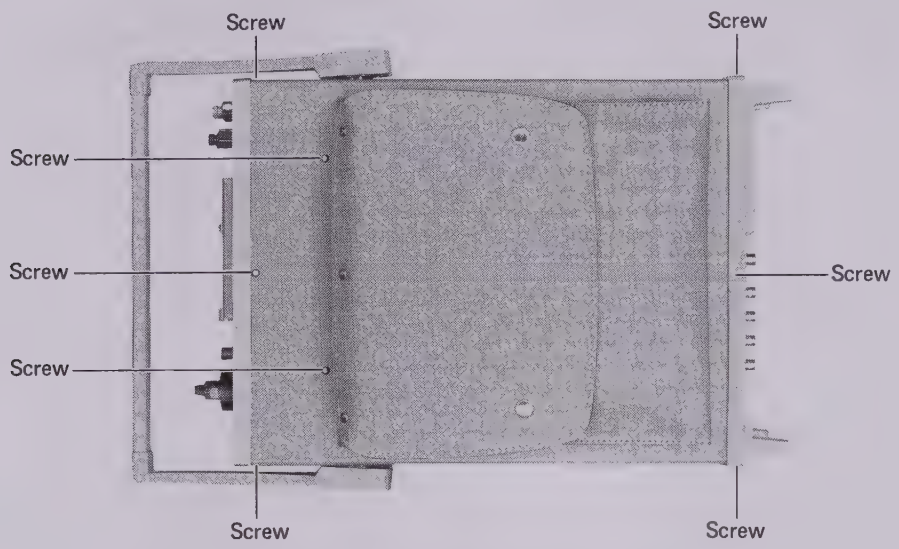
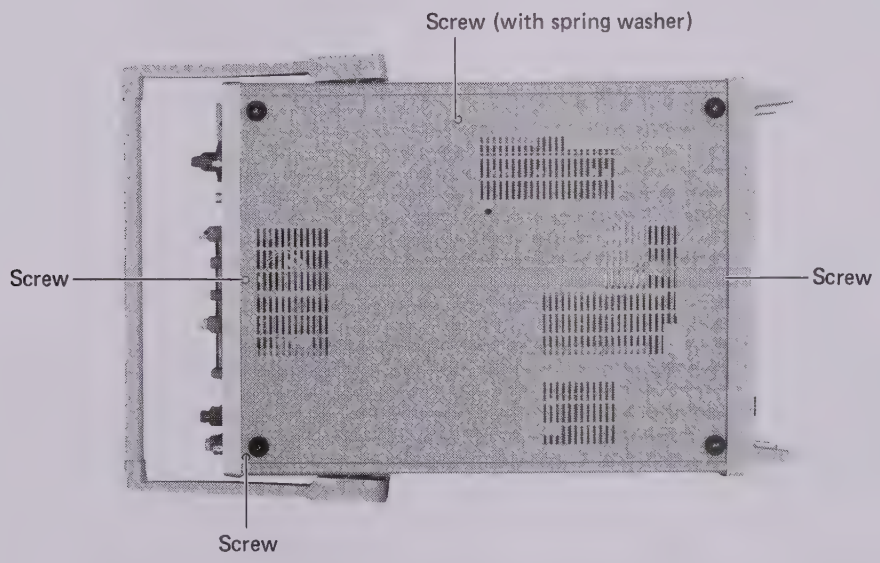


Figure 3-2-1-3. Screw Locations on Bottom



3-2-2 Printed Circuit Board Removal

Removal of each board is accomplished by the following steps, but disconnect the connectors and cables attached on the board is necessary.

Top

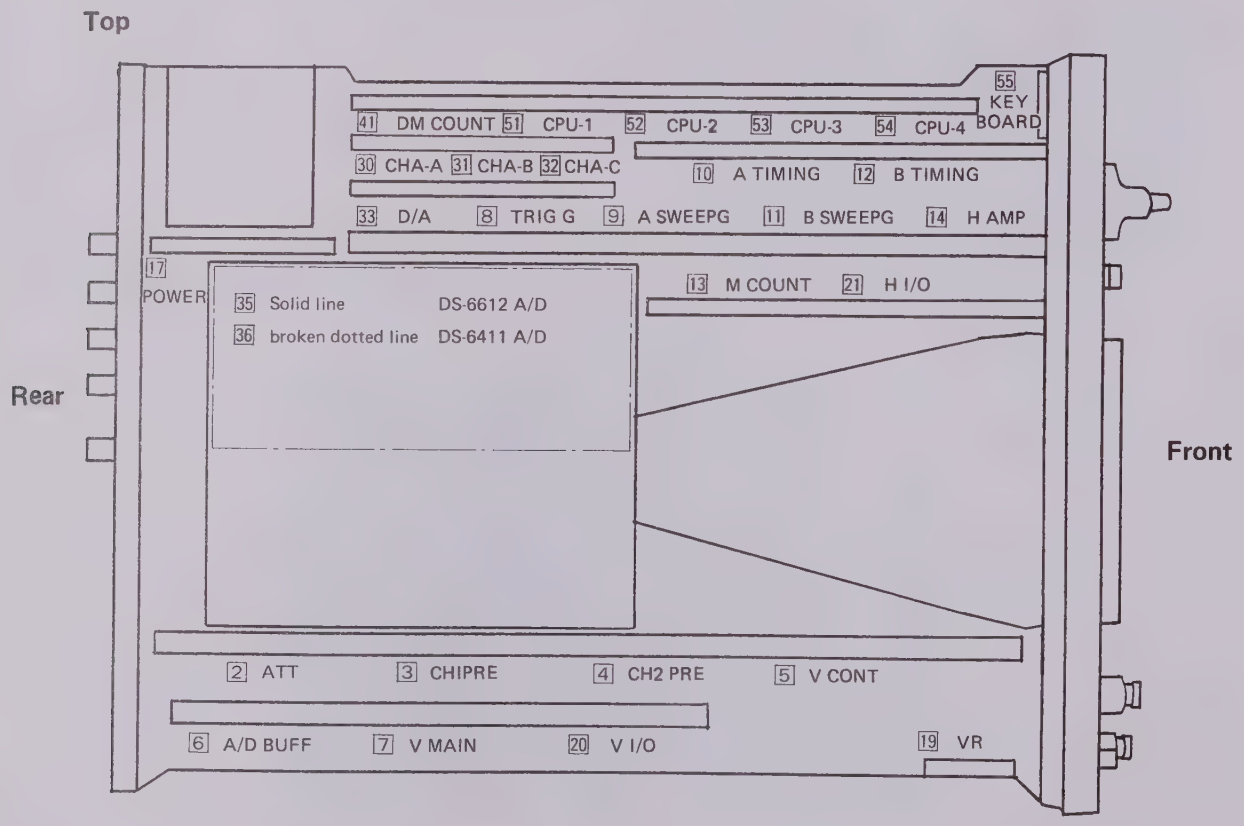
See Figure 3-2-2-1.

a. POWER SUPPLY
   1. Remove four screws that fasten the FAN.
   2. Lifts FAN and POWER SUPPLY from the chassis.

b. AD converter
   1. Remove four screws that fasten the AD converter.
   2. Lift it from the chassis.

c. M COUNT and H I/O
   1. Remove two screws that fasten the M COUNT.
   2. Slightly pull the M COUNT board rear-word.
   3. Lift it from the chassis.

Figure 3-2-2-1. P.C. Bs on Top

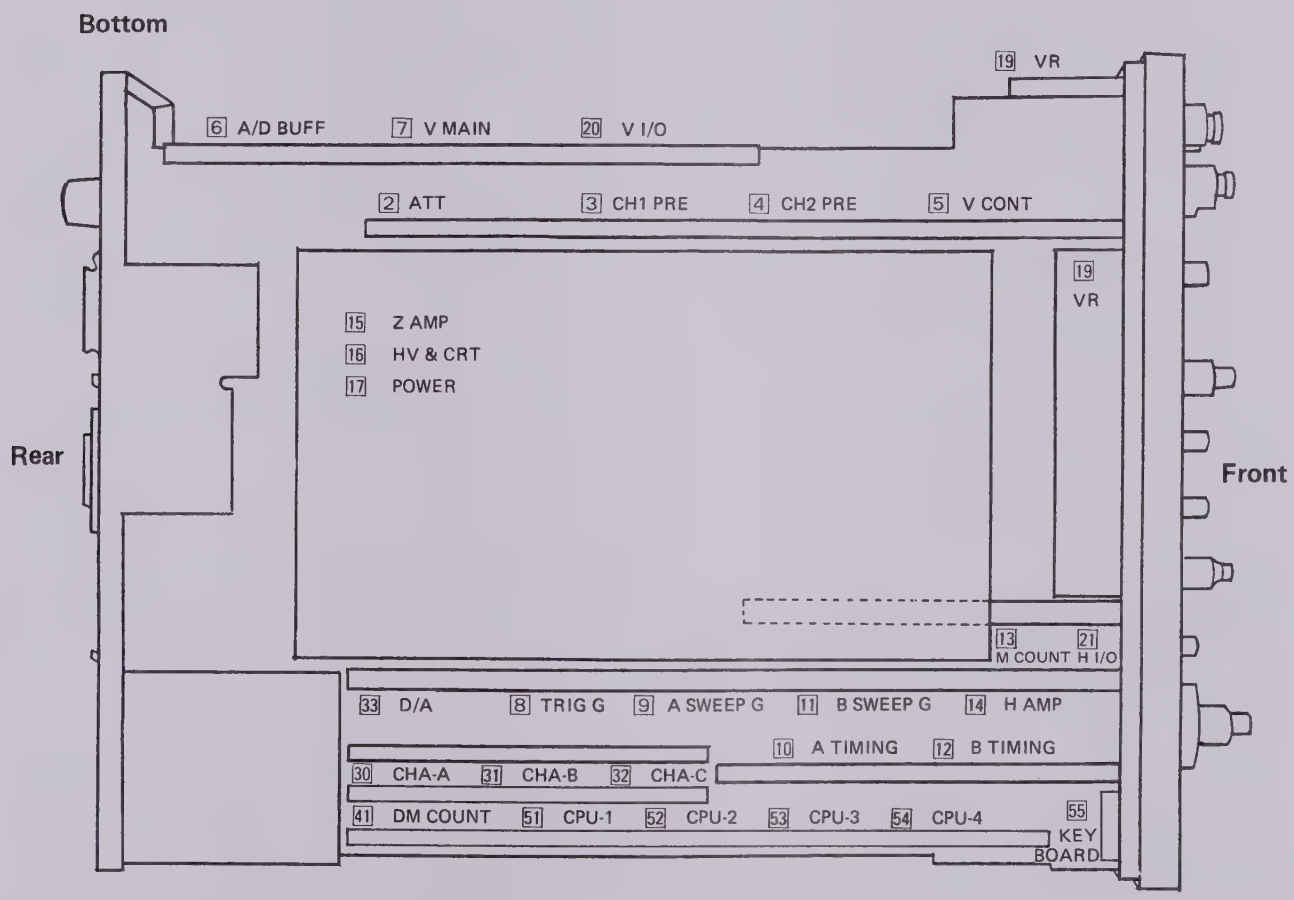

Top
55 KEY BOARD
41 DM COUNT 51 CPU-1 52 CPU-2 53 CPU-3 54 CPU-4
30 CHA-A 31 CHA-B 32 CHA-C
10 A TIMING 12 B TIMING
33 D/A 8 TRIG G 9 A SWEEPG 11 B SWEEPG 14 H AMP
17 POWER
13 M COUNT 21 H I/O
35 Solid line DS-6612 A/D
36 broken dotted line DS-6411 A/D
Rear
Front
2 ATT 3 CHIPRE 4 CH2 PRE 5 V CONT
6 A/D BUFF 7 V MAIN 20 V I/O 19 VR

Bottom

See Figure 3-2-2-2.

a. Z AMP, HV & CRT and POWER
   1. Remove EXTENSION SHAFT, POWER switch and FOCUS control.
   2. Remove four screws that fasten ZAMP, HV & CRT and POWER board.
   3. Lift it from the chassis.

Figure 3-2-2-2. P.C. Bs on Bottom

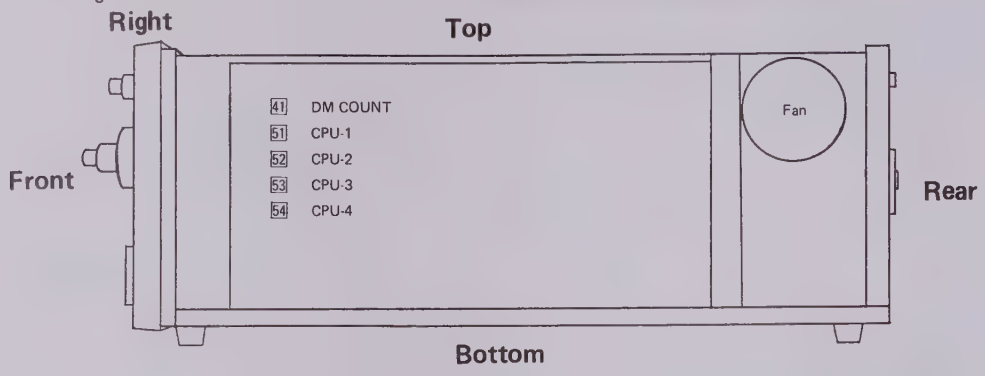


Right Side

a. DM COUNT and CPU board

1. Remove a screw that fasten DM COUNT and CPU board.
2. Lift it from the chassis.

Figure 3-2-2-3. P.C.Bs on Right Side



Left Side

a. V MAIN AMP board

1. Remove four screws that fasten V MAIN AMP board.
2. Lift it from the chassis.

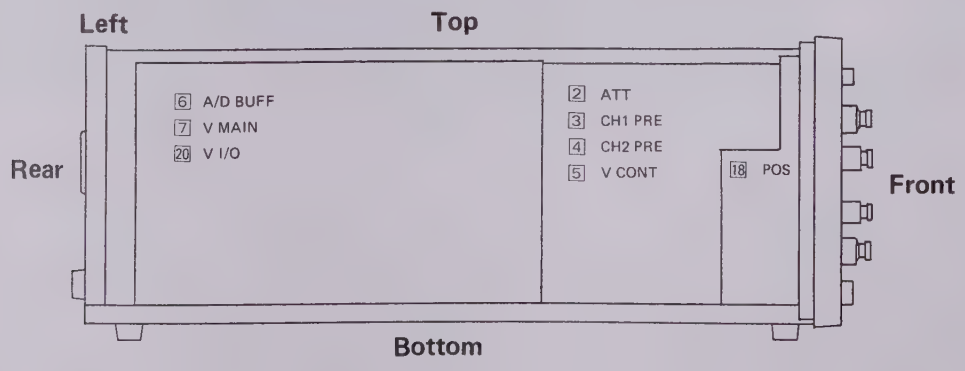
b. POS board

1. Remove two knobs (CH1, CH2 POSITION) that fasten POS board.
2. Pull the POS board rear-word.

c. ATT board

1. Remove screws that fasten ATT board.
2. Remove two knobs (CH1, CH2 VOLT/DIV that fasten ATT board).
3. Lift it from chassis.

Figure 3-2-2-4. P.C.Bs on Left Side



3-2-3 Printed Circuit Board Parts Replacement

In replacing diodes, transistors, IC's, resistors, or capacitors, on a printed circuit board, use your soldering iron carefully so that neither the copper foil of the printed circuit board will be peeled off nor any parts on the circuit board will be damaged.

Because the semiconductors, such as transistors and diodes, are not thermal-resistant, pinch the leads with tweezers and solder them quickly component so that the heat of the soldering iron will not be directly conveyed to the semiconductor. Diodes and transistors used for replacement have good performance.

The resistros, capacitors, and other passive elements used in the instrument are carefully selected so any replacement parts to be used in their place must have good ones. (See Section 6 Electrical Parts List.)

Electrode contact of transistor or diode and serious variation of their characteristics may incidentally make a resistor burn or a capacitor short-circuit. If such a trouble should occur, eliminate the cause of it before replacing the faulty part.

3-2-4 Replacing Resistors, Diodes or ICs

In replacing a transistor, diode, or IC, make sure of the electrodes.

Particularly, transistors must be replaced with ones that have good performance. The transistors that have been specially selected are moted in the schematic diagrams.

3-2-5 High-Voltage Power Transformer Replacement

Care must be taken in replacing the high-voltage power transformer which supplies high voltage to the CRT because the CRT circuit may be live with high voltage. The removal procedure is as follows:

1. Remove the rear panel, and top and bottom covers.
2. Remove the A/D board, and A/D hold board.
3. Remove the two screws that fasten the high-voltage case.
4. Remove the three screws that fasten the shield board on the MAIN board.
5. The high-voltage power transformer is soldered on the printed circuit board. It must be unsoldered by using a soldering iron. When the high-voltage power transformer has been replaced, readjustment is necessary.

3-2-6 CRT Replacement

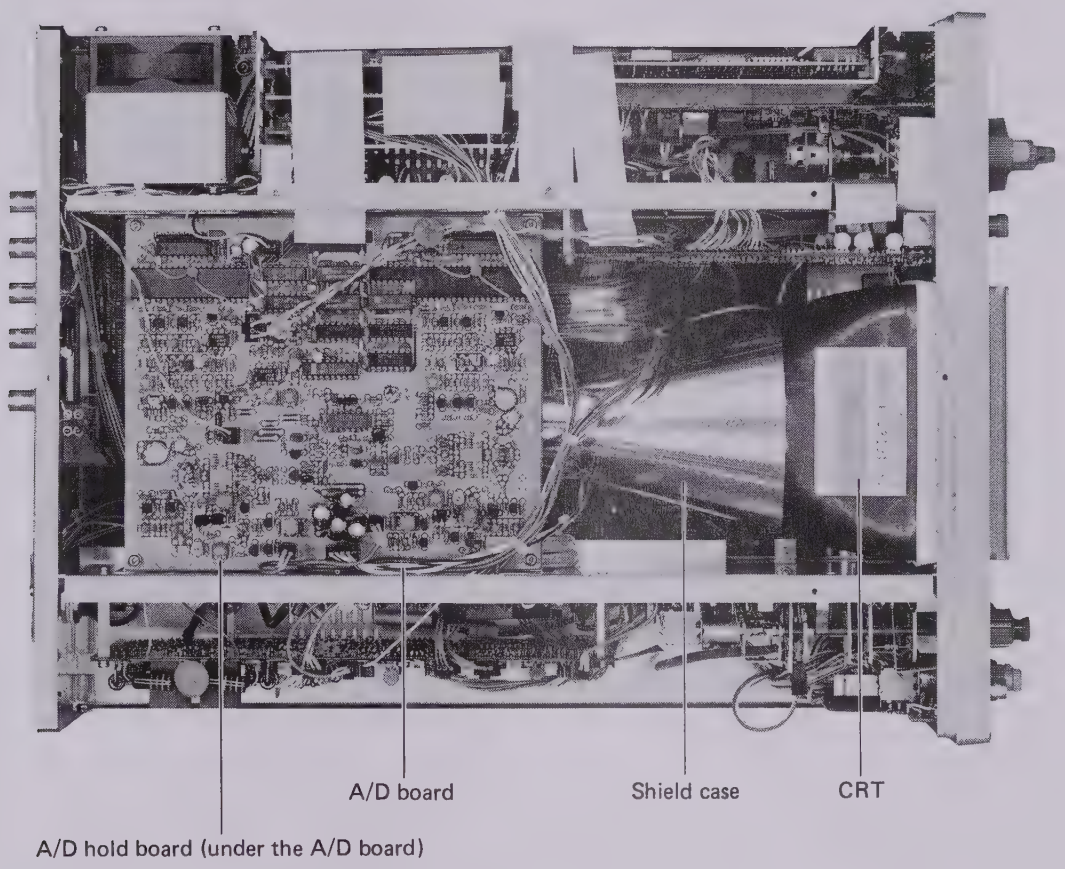
Handle the CRT carefully in replacing it because it will be damaged easily by dropping or shock. Care must be also taken not to apply too much strain to the electrode to prevent the glass from cracking.

The CRT removal procedure is as follows:

1. Remove the rear panel and the top cover.
2. Remove the A/D board and A/D hold board.
3. Remove the two screws that fasten the CRT clamps sub panel.
4. Disconnect the CRT socket.
5. Remove the anode cap after discharging it because it might retain a high voltage charge.
6. The ground line is soldered the shield case of CRT. It must be unsoldered by using a sholdering iron.
7. Disconnect the leads (white, black) from the connector J1601 for the trace rotation.
8. Slightly pull the CRT and shield case rear-ward, lift the front end of the CRT and pull it forward until it comes out.
9. Pull the CRT carefully from the shield case.

Reverse the above procedure for installing the CRT. If the CRT has been replaced, readjustments must be made by referring to "Section 4 Check and Adjustment".

Figure 3-2-6-1. CRT Replacement



3-3 TROUBLESHOOTING

3-3-1 Troubleshooting Reference

Schematic Diagrams

Complete schematic diagrams are located on tabbed foldout pages in the "Section 5 Schematic Diagram".

Circuit Board Locations

The placement in the instrument of each circuit board is shown in 3-2-2 Printed Circuit Board Location (see page 3-4).

3-3-2 Instruments Required for Troubleshooting

The following instruments are required at least for troubleshooting of this oscilloscope.

1. Multimeter

Input resistance	10 MΩ
Voltage range	0 to 300V and special position for 2 kV
Ohm-range	0 to 100 MΩ

2. Transistor Curve Tracer
3. Oscilloscope

Frequency response	DC to 100 MHz
Deflection factor	5 mV/div

3-3-3 Troubleshooting Steps

The first thing in troubleshooting is to examine if a irregular event like "a circuit trouble" is really due to a troubles within the circuit, or caused by external events. For example, certain irregular operations will occur, in a normal oscilloscope, if the line voltage is out of the rated voltage renge, or a signal input connector is affected by induction of an external signal.

Then, repeatability of the trouble must be checked. For example, when sweep is normal but an irregular signal is displayed with a signal supplied to the signal input connector, the other signal must be supplied to the input to check if the same irregular display occurs (if it occurs, the oscilloscope is responsible for the trouble).

When troubles persist against these preparatory checks, the following actual steps must be performed.

1. Remove the covers from the instrument and ascertain the circuit which has the trouble by the troubleshooting flow chart.
2. Visually inspect parts, wirings, coupling of connectors, soldering and copper foils of the circuit board, which are suspect.
3. Check the action of the ascertained circuit by using a multimeter or test oscilloscope and refering the voltages and waveforms shown in the schematic diagram.
4. Finally, check suspect parts for the trouble by using a multimeter or curve tracer and replace the defective parts.

Troubleshooting Chart Index

Real Section

REAL

START

Mechanical section 3-14

Power Supply 3-14

CRT Display 3-15

Character Display 3-16

Culibrator 3-17

Pannel Setting 3-17

Vertical System 3-19

Horizontal System 3-20

Triggering 3-21

END 3-21

Storage Section

STORAGE

START

Initialize 3-22

Key Operation Parts 3-23

Rotary Encoder 3-24

Storage Portion 3-24

Storage Operation 3-25

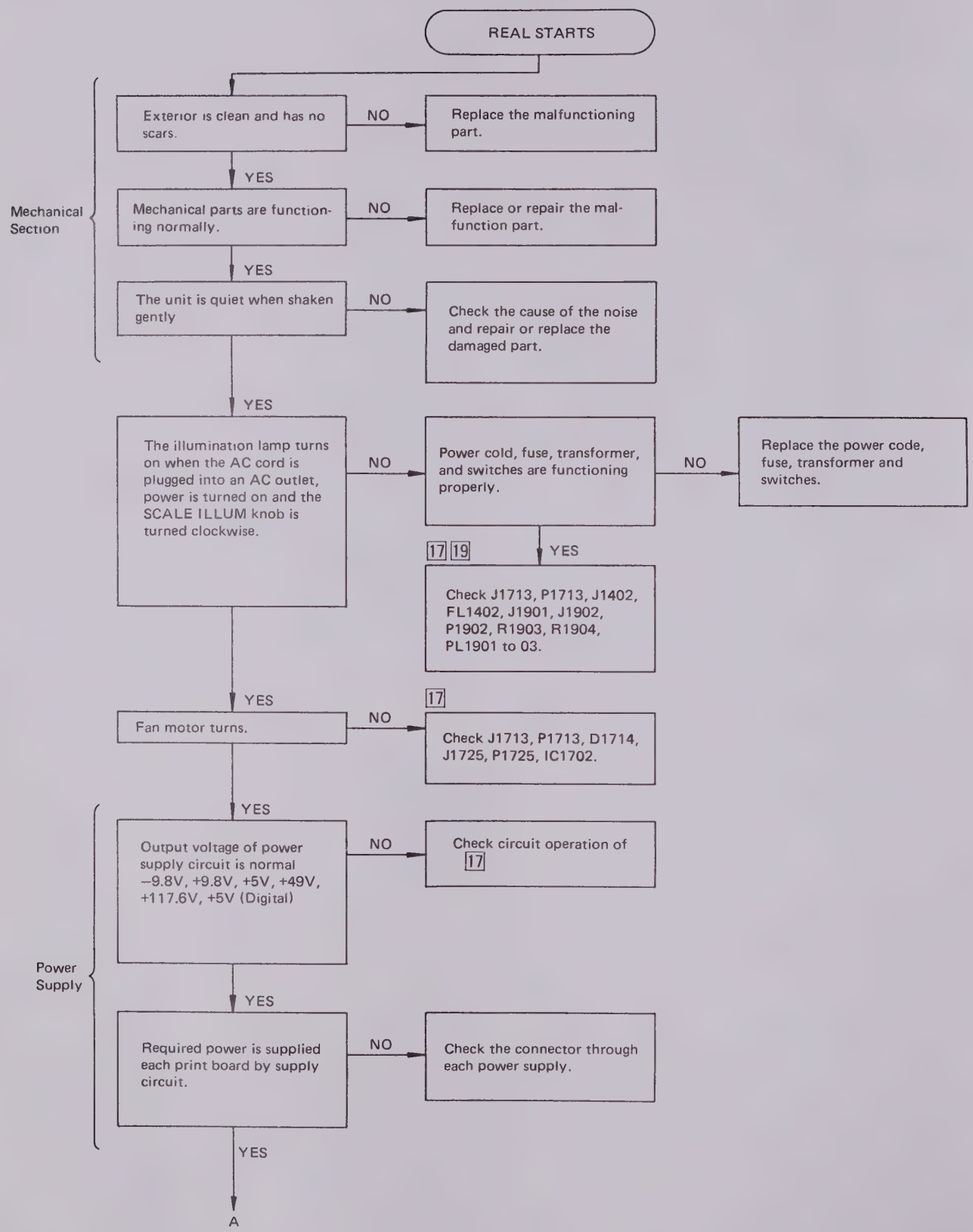
END 3-25

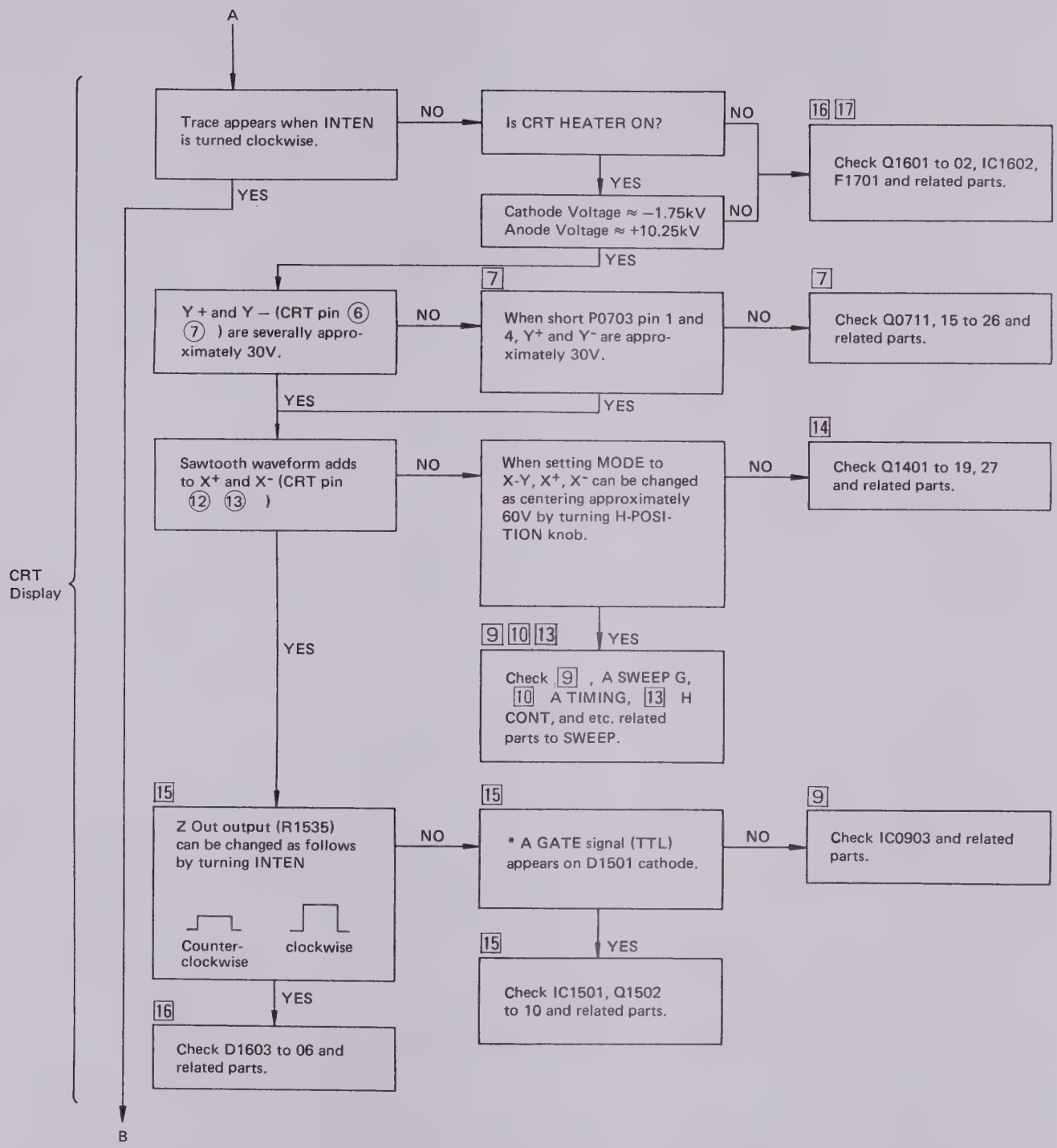
Display Portion 3-26

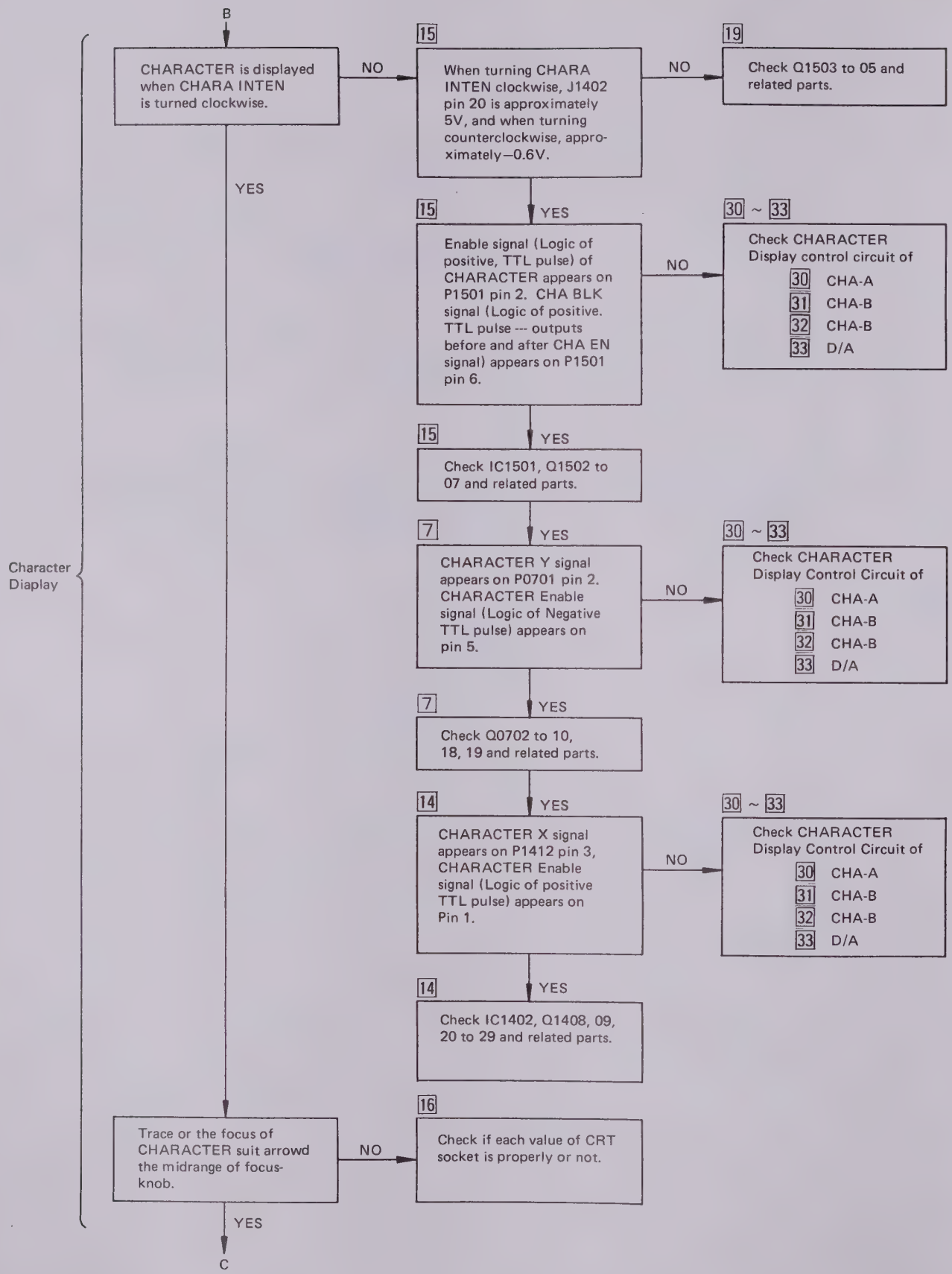
DM Portion 3-29

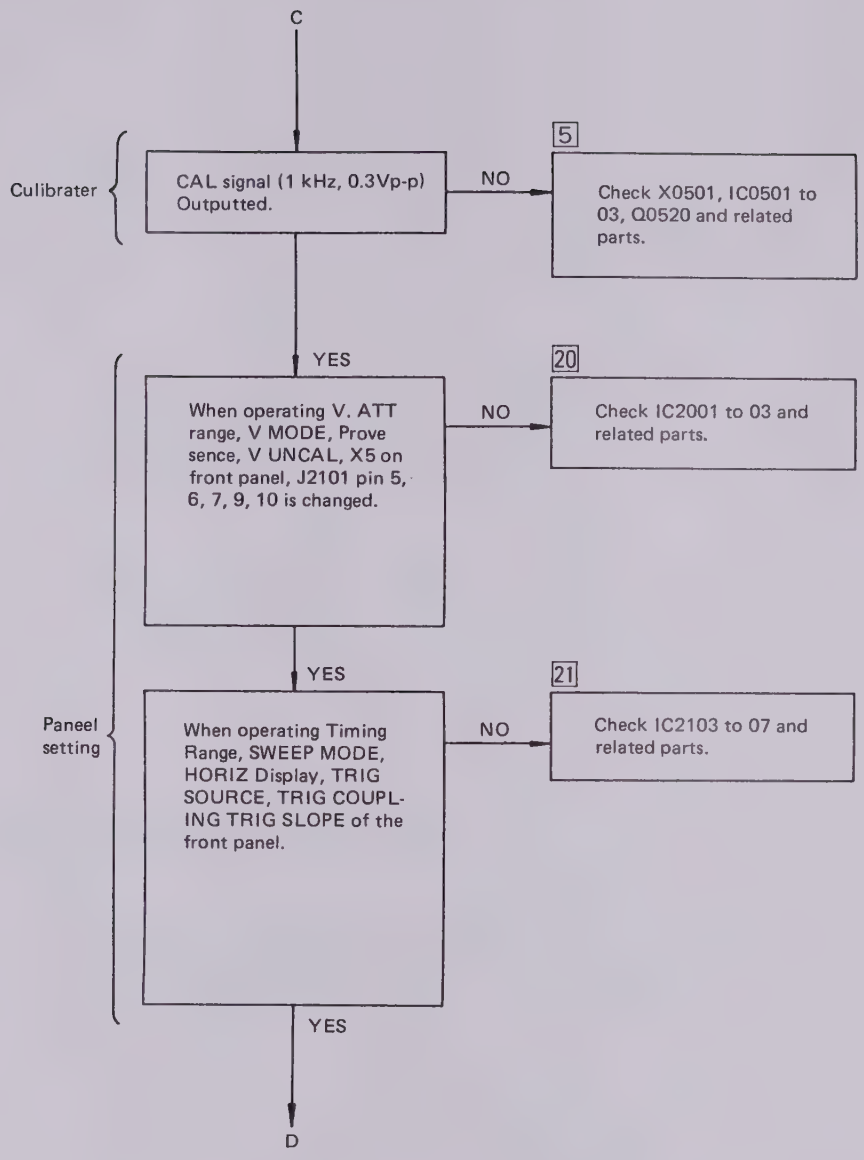
A/D Portion 3-30

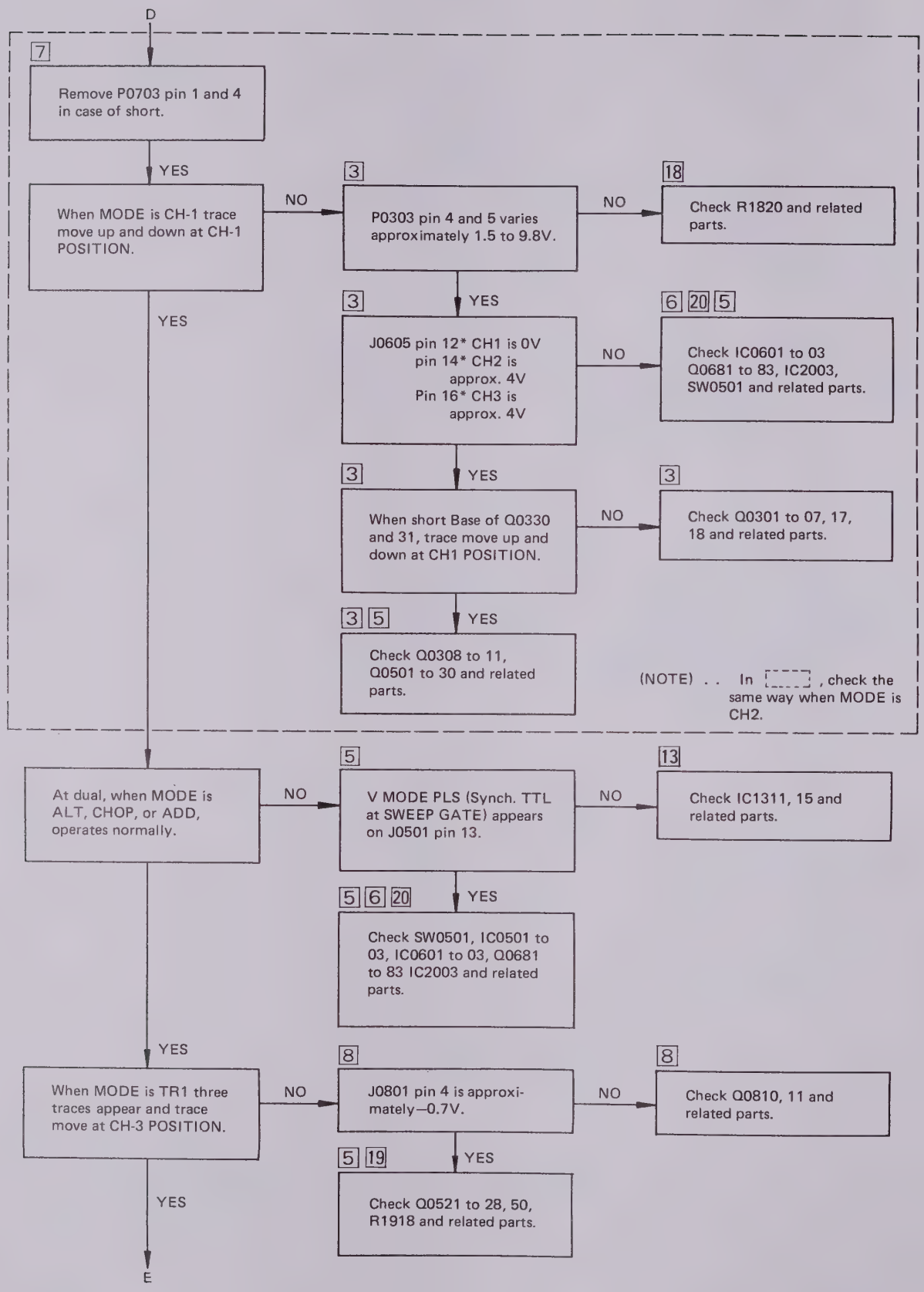
REAL

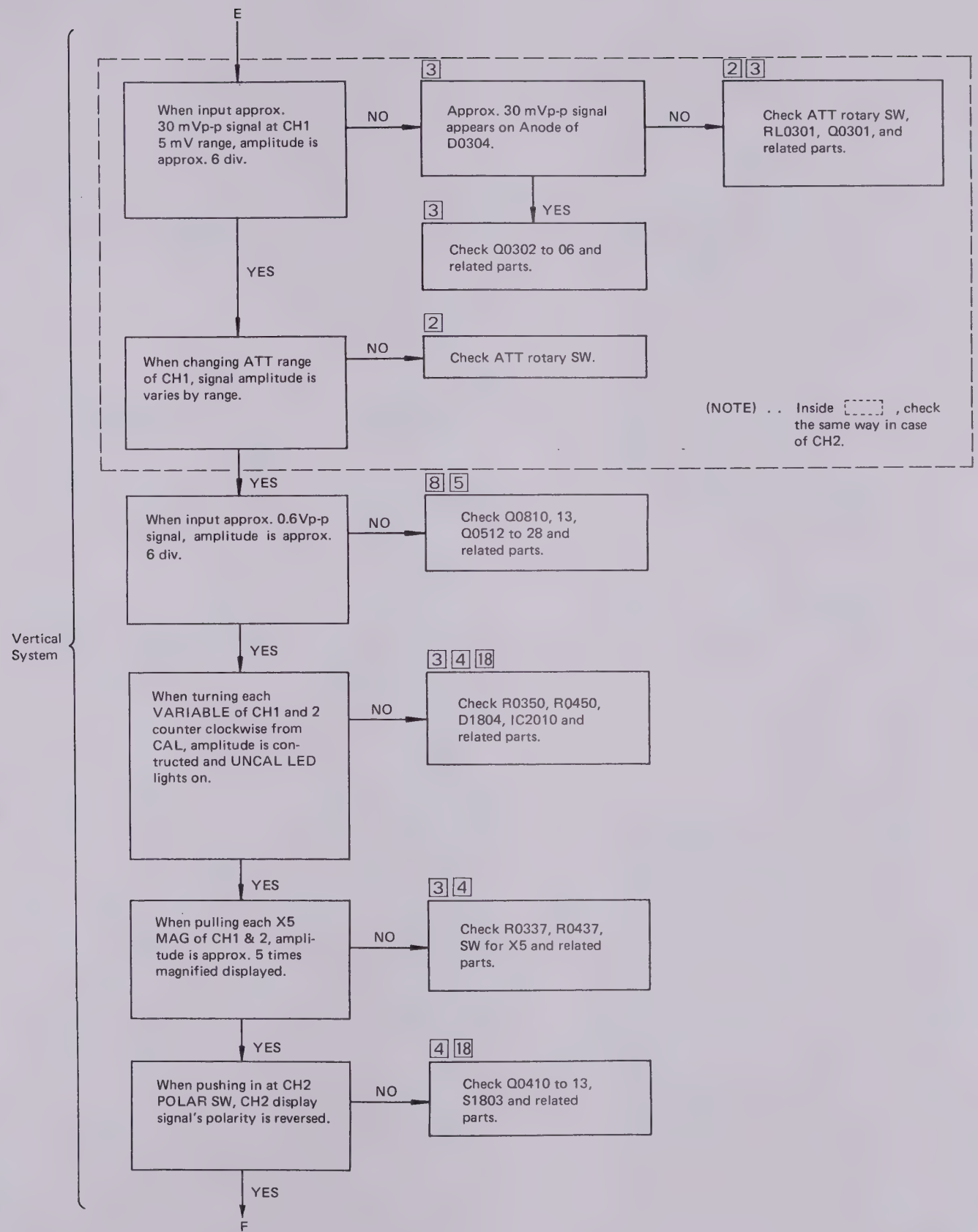

REAL STARTS
Mechanical Section
Exterior is clean and has no scars.
NO
Replace the malfunctioning part.
YES
Mechanical parts are functioning normally.
NO
Replace or repair the malfunction part.
YES
The unit is quiet when shaken gently
NO
Check the cause of the noise and repair or replace the damaged part.
YES
The illumination lamp turns on when the AC cord is plugged into an AC outlet, power is turned on and the SCALE ILLUM knob is turned clockwise.
NO
Power cold, fuse, transformer, and switches are functioning properly.
NO
Replace the power code, fuse, transformer and switches.
17 19
YES
Check J1713, P1713, J1402, FL1402, J1901, J1902, P1902, R1903, R1904, PL1901 to 03.
YES
17
Fan motor turns.
NO
Check J1713, P1713, D1714, J1725, P1725, IC1702.
YES
Power Supply
Output voltage of power supply circuit is normal −9.8V, +9.8V, +5V, +49V, +117.6V, +5V (Digital)
NO
Check circuit operation of 17
YES
Required power is supplied each print board by supply circuit.
NO
Check the connector through each power supply.
YES
A

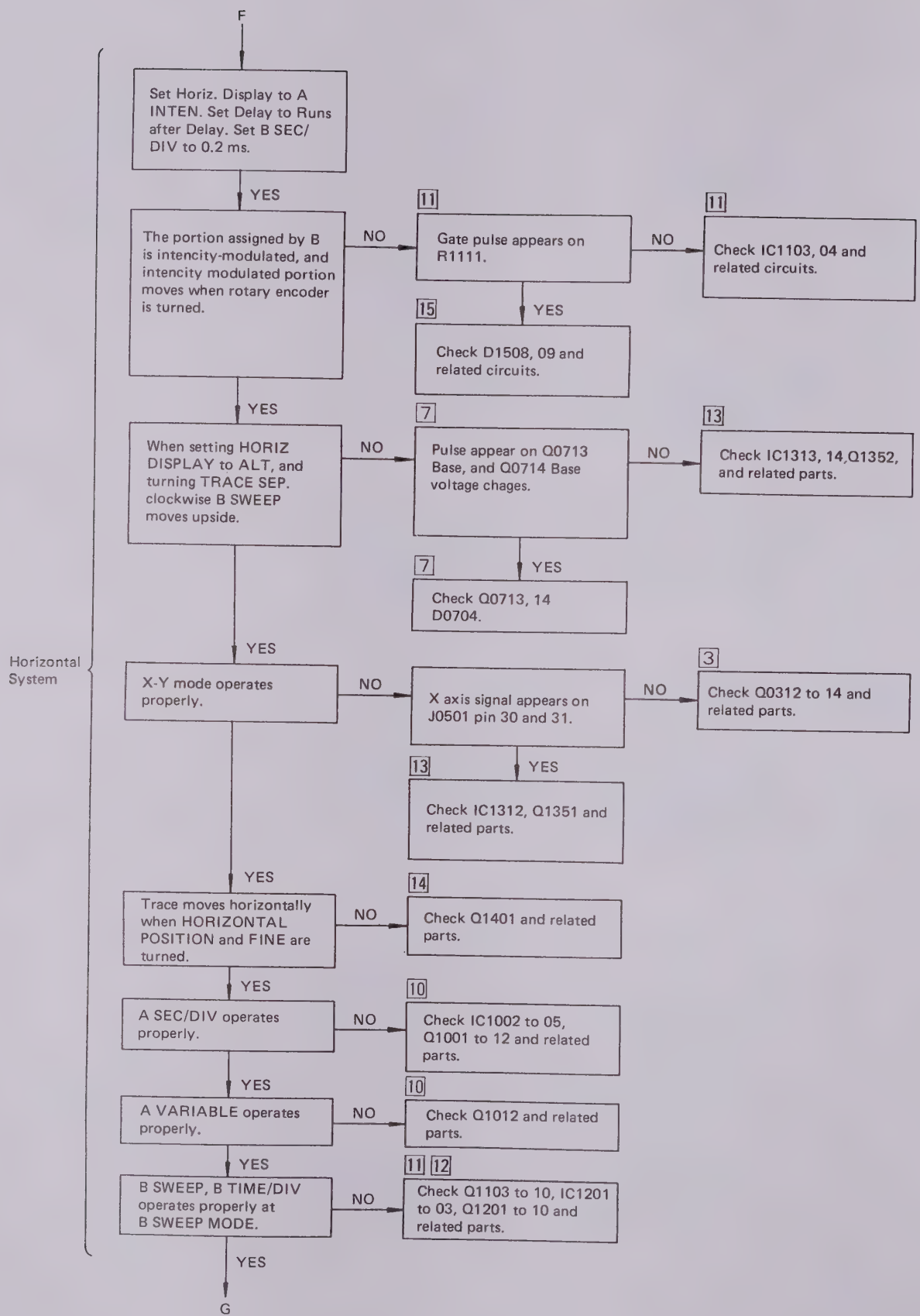

A
Trace appears when INTEN is turned clockwise.
NO
Is CRT HEATER ON?
NO
16 17
Check Q1601 to 02, IC1602, F1701 and related parts.
YES
YES
Cathode Voltage ≈ −1.75kV
Anode Voltage ≈ +10.25kV
NO
YES
7
Y + and Y − (CRT pin ⑥ ⑦) are severally approximately 30V.
NO
When short P0703 pin 1 and 4, Y+ and Y- are approximately 30V.
NO
7
Check Q0711, 15 to 26 and related parts.
YES
YES
14
Sawtooth waveform adds to X+ and X- (CRT pin ⑫ ⑬)
NO
When setting MODE to X-Y, X+, X- can be changed as centering approximately 60V by turning H-POSITION knob.
NO
Check Q1401 to 19, 27 and related parts.
9 10 13
YES
Check 9 , A SWEEP G, 10 A TIMING, 13 H CONT, and etc. related parts to SWEEP.
YES
15
Z Out output (R1535) can be changed as follows by turning INTEN
Counter-clockwise
clockwise
NO
15
* A GATE signal (TTL) appears on D1501 cathode.
NO
9
Check IC0903 and related parts.
15
YES
Check IC1501, Q1502 to 10 and related parts.
YES
16
Check D1603 to 06 and related parts.
CRT Display
B

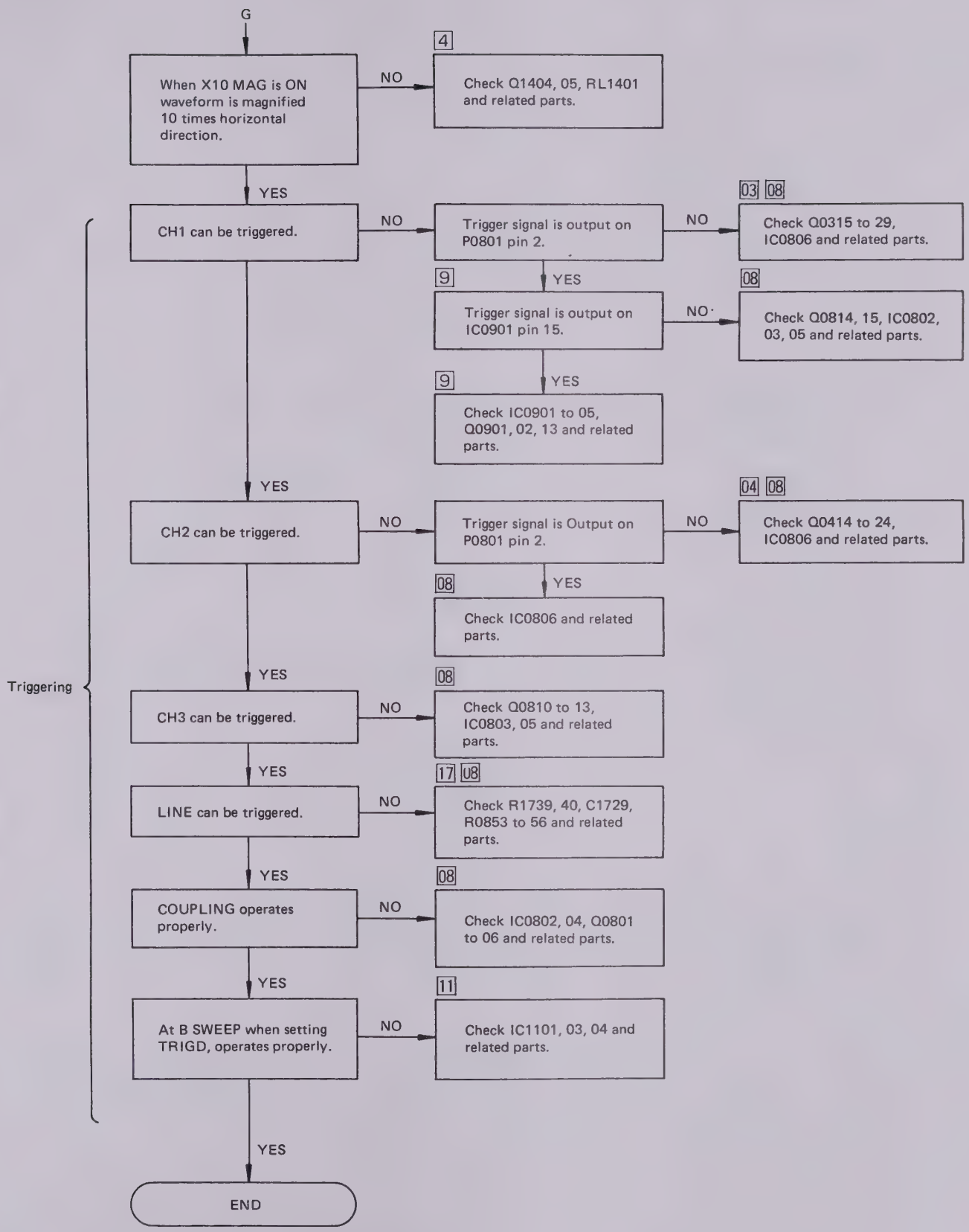

B
CHARACTER is displayed when CHARA INTEN is turned clockwise.
NO
15
When turning CHARA INTEN clockwise, J1402 pin 20 is approximately 5V, and when turning counterclockwise, approximately −0.6V.
NO
19
Check Q1503 to 05 and related parts.
YES
15
YES
Enable signal (Logic of positive, TTL pulse) of CHARACTER appears on P1501 pin 2. CHA BLK signal (Logic of positive. TTL pulse --- outputs before and after CHA EN signal) appears on P1501 pin 6.
NO
30 ~ 33
Check CHARACTER Display control circuit of
30 CHA-A
31 CHA-B
32 CHA-B
33 D/A
15
YES
Check IC1501, Q1502 to 07 and related parts.
7
YES
CHARACTER Y signal appears on P0701 pin 2. CHARACTER Enable signal (Logic of Negative TTL pulse) appears on pin 5.
NO
30 ~ 33
Check CHARACTER Display Control Circuit of
30 CHA-A
31 CHA-B
32 CHA-B
33 D/A
7
YES
Check Q0702 to 10, 18, 19 and related parts.
14
YES
CHARACTER X signal appears on P1412 pin 3, CHARACTER Enable signal (Logic of positive TTL pulse) appears on Pin 1.
NO
30 ~ 33
Check CHARACTER Display Control Circuit of
30 CHA-A
31 CHA-B
32 CHA-B
33 D/A
14
YES
Check IC1402, Q1408, 09, 20 to 29 and related parts.
Trace or the focus of CHARACTER suit arrowd the midrange of focus-knob.
NO
16
Check if each value of CRT socket is properly or not.
YES
C
Character Diaplay


C
Culibrater
CAL signal (1 kHz, 0.3Vp-p) Outputted.
NO
5
Check X0501, IC0501 to 03, Q0520 and related parts.
YES
When operating V. ATT range, V MODE, Prove sence, V UNCAL, X5 on front panel, J2101 pin 5, 6, 7, 9, 10 is changed.
NO
20
Check IC2001 to 03 and related parts.
YES
Paneel setting
When operating Timing Range, SWEEP MODE, HORIZ Display, TRIG SOURCE, TRIG COUPLING TRIG SLOPE of the front panel.
NO
21
Check IC2103 to 07 and related parts.
YES
D

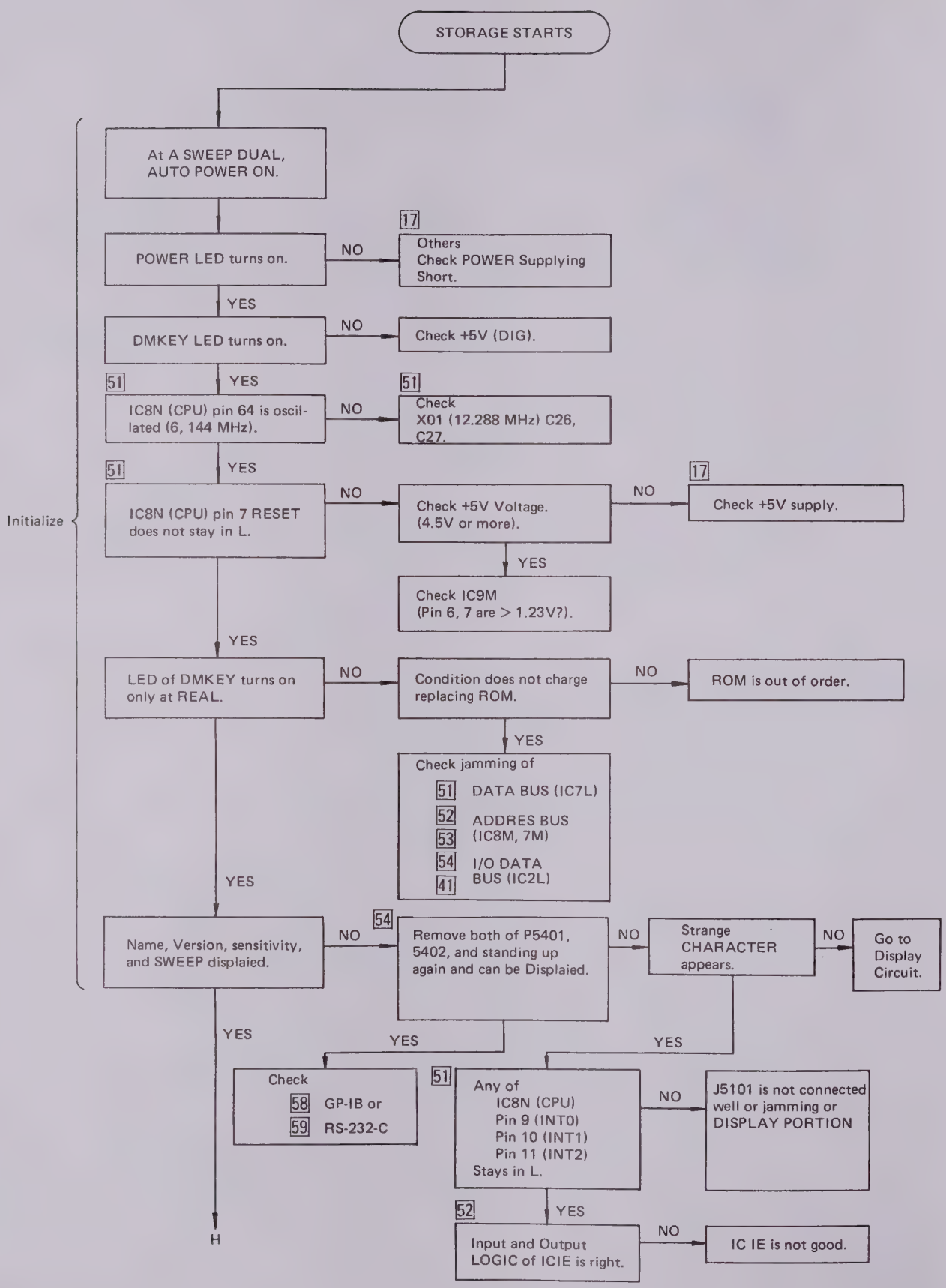

D
7
Remove P0703 pin 1 and 4 in case of short.
YES
When MODE is CH-1 trace move up and down at CH-1 POSITION.
NO
3
P0303 pin 4 and 5 varies approximately 1.5 to 9.8V.
NO
18
Check R1820 and related parts.
YES
3
J0605 pin 12* CH1 is 0V
pin 14* CH2 is approx. 4V
Pin 16* CH3 is approx. 4V
NO
6 20 5
Check IC0601 to 03 Q0681 to 83, IC2003, SW0501 and related parts.
YES
3
When short Base of Q0330 and 31, trace move up and down at CH1 POSITION.
NO
3
Check Q0301 to 07, 17, 18 and related parts.
YES
3 5
Check Q0308 to 11, Q0501 to 30 and related parts.
YES
(NOTE) . . In [ ] , check the same way when MODE is CH2.
At dual, when MODE is ALT, CHOP, or ADD, operates normally.
NO
5
V MODE PLS (Synch. TTL at SWEEP GATE) appears on J0501 pin 13.
NO
13
Check IC1311, 15 and related parts.
5 6 20
Check SW0501, IC0501 to 03, IC0601 to 03, Q0681 to 83 IC2003 and related parts.
YES
When MODE is TR1 three traces appear and trace move at CH-3 POSITION.
NO
8
J0801 pin 4 is approximately—0.7V.
NO
8
Check Q0810, 11 and related parts.
5 19
Check Q0521 to 28, 50, R1918 and related parts.
YES
YES
YES
E

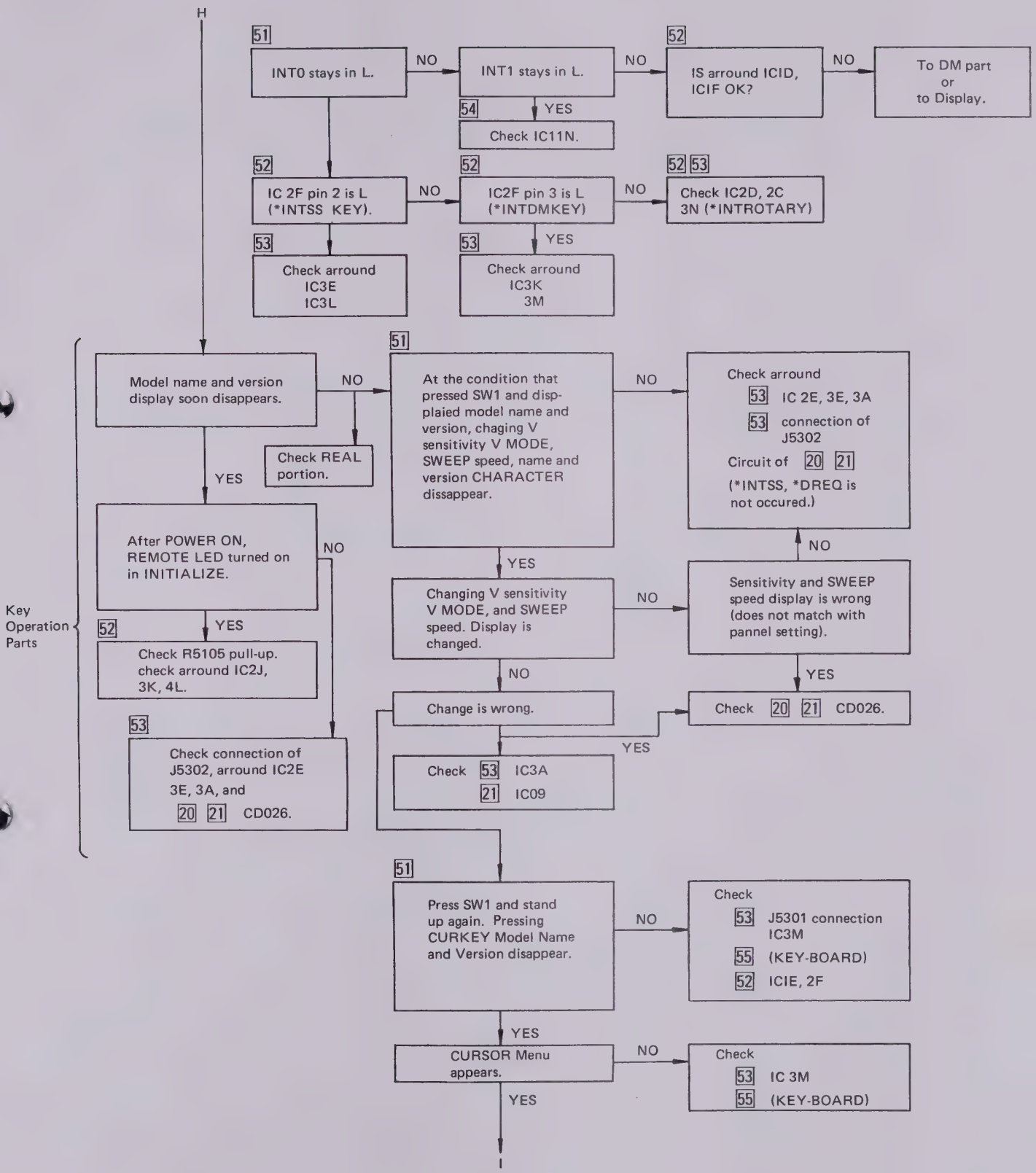

E
Vertical System
When input approx. 30 mVp-p signal at CH1 5 mV range, amplitude is approx. 6 div.
NO
3
Approx. 30 mVp-p signal appears on Anode of D0304.
NO
2 3
Check ATT rotary SW, RL0301, Q0301, and related parts.
3
YES
Check Q0302 to 06 and related parts.
YES
When changing ATT range of CH1, signal amplitude is varies by range.
NO
2
Check ATT rotary SW.
(NOTE) . . Inside [ ] , check the same way in case of CH2.
YES
When input approx. 0.6Vp-p signal, amplitude is approx. 6 div.
NO
8 5
Check Q0810, 13, Q0512 to 28 and related parts.
YES
When turning each VARIABLE of CH1 and 2 counter clockwise from CAL, amplitude is contructed and UNCAL LED lights on.
NO
3 4 18
Check R0350, R0450, D1804, IC2010 and related parts.
YES
When pulling each X5 MAG of CH1 & 2, amplitude is approx. 5 times magnified displayed.
NO
3 4
Check R0337, R0437, SW for X5 and related parts.
YES
When pushing in at CH2 POLAR SW, CH2 display signal's polarity is reversed.
NO
4 18
Check Q0410 to 13, S1803 and related parts.
YES
F

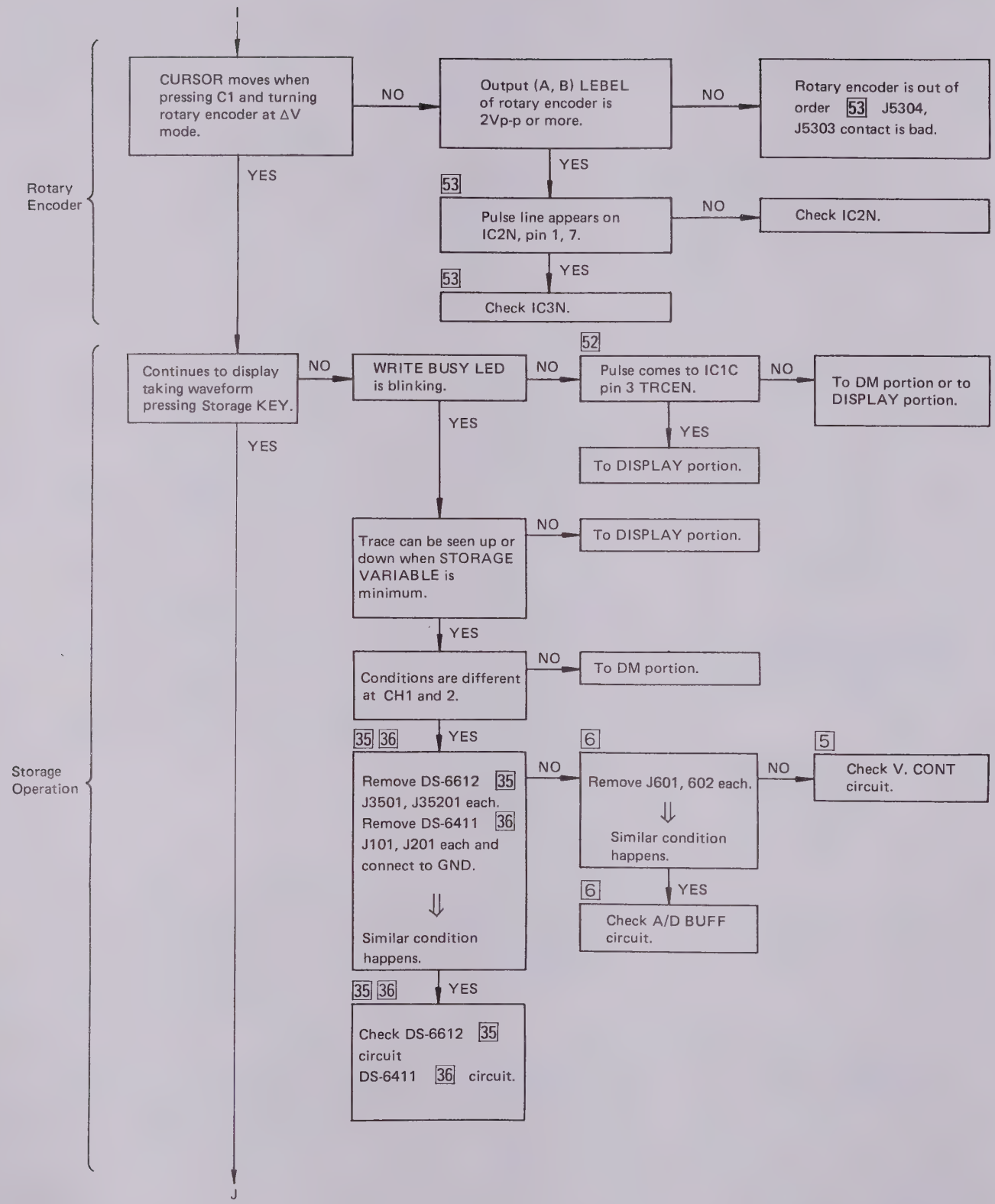

F
Set Horiz. Display to A INTEN. Set Delay to Runs after Delay. Set B SEC/DIV to 0.2 ms.
YES
The portion assigned by B is intencity-modulated, and intencity modulated portion moves when rotary encoder is turned.
NO
11
Gate pulse appears on R1111.
NO
11
Check IC1103, 04 and related circuits.
15
YES
Check D1508, 09 and related circuits.
YES
When setting HORIZ DISPLAY to ALT, and turning TRACE SEP. clockwise B SWEEP moves upside.
NO
7
Pulse appear on Q0713 Base, and Q0714 Base voltage chages.
NO
13
Check IC1313, 14,Q1352, and related parts.
7
YES
Check Q0713, 14 D0704.
YES
X-Y mode operates properly.
NO
X axis signal appears on J0501 pin 30 and 31.
NO
3
Check Q0312 to 14 and related parts.
13
YES
Check IC1312, Q1351 and related parts.
YES
Trace moves horizontally when HORIZONTAL POSITION and FINE are turned.
NO
14
Check Q1401 and related parts.
YES
A SEC/DIV operates properly.
NO
10
Check IC1002 to 05, Q1001 to 12 and related parts.
YES
A VARIABLE operates properly.
NO
10
Check Q1012 and related parts.
YES
B SWEEP, B TIME/DIV operates properly at B SWEEP MODE.
NO
11 12
Check Q1103 to 10, IC1201 to 03, Q1201 to 10 and related parts.
YES
G
Horizontal System

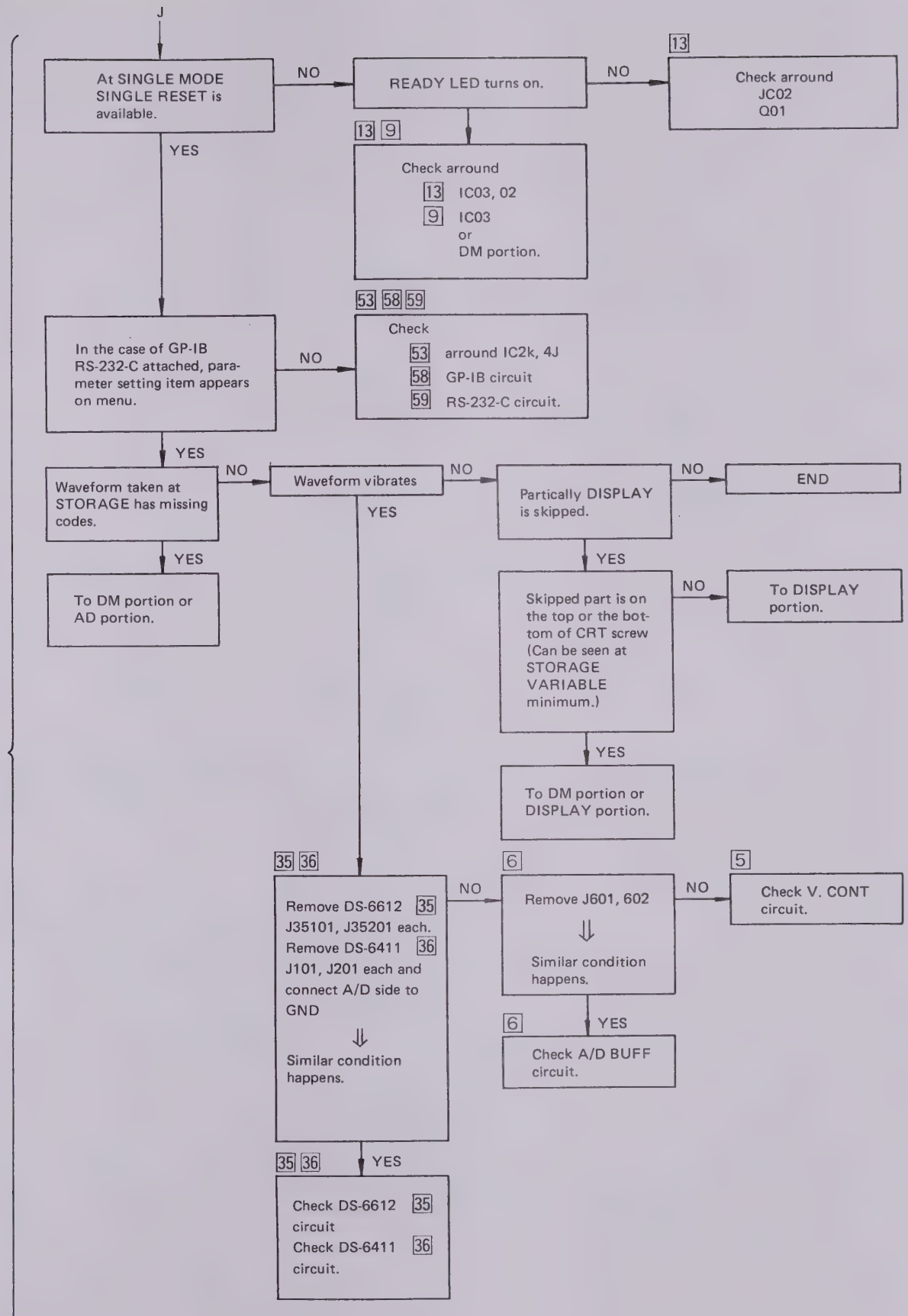

G
When X10 MAG is ON waveform is magnified 10 times horizontal direction.
NO
4
Check Q1404, 05, RL1401 and related parts.
YES
CH1 can be triggered.
NO
Trigger signal is output on P0801 pin 2.
NO
03 08
Check Q0315 to 29, IC0806 and related parts.
9
YES
Trigger signal is output on IC0901 pin 15.
NO
08
Check Q0814, 15, IC0802, 03, 05 and related parts.
9
YES
Check IC0901 to 05, Q0901, 02, 13 and related parts.
YES
CH2 can be triggered.
NO
Trigger signal is Output on P0801 pin 2.
NO
04 08
Check Q0414 to 24, IC0806 and related parts.
08
YES
Check IC0806 and related parts.
YES
CH3 can be triggered.
NO
08
Check Q0810 to 13, IC0803, 05 and related parts.
YES
LINE can be triggered.
NO
17 08
Check R1739, 40, C1729, R0853 to 56 and related parts.
YES
COUPLING operates properly.
NO
08
Check IC0802, 04, Q0801 to 06 and related parts.
YES
At B SWEEP when setting TRIGD, operates properly.
NO
11
Check IC1101, 03, 04 and related parts.
YES
END
Triggering

STORAGE

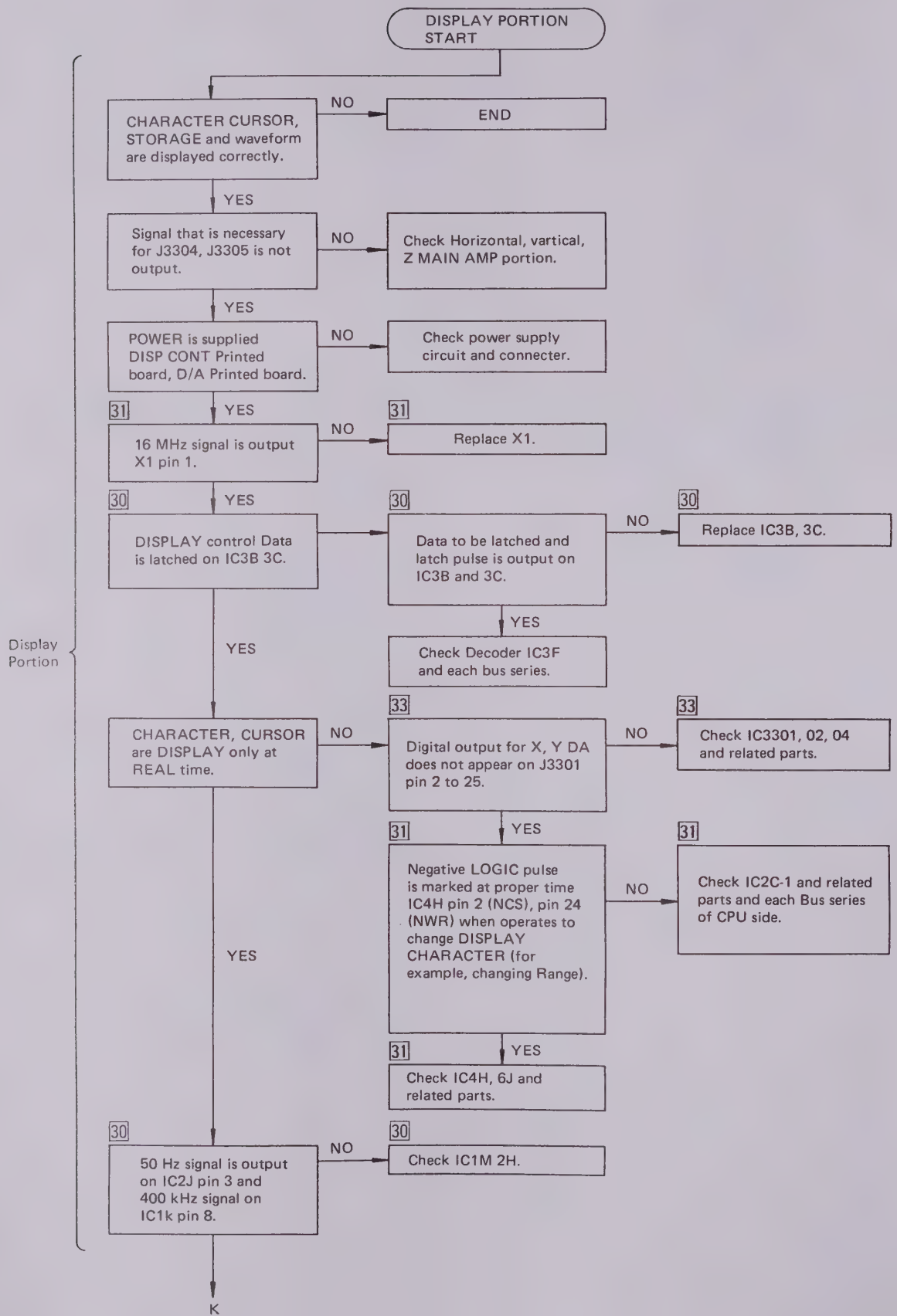

STORAGE STARTS
Initialize
At A SWEEP DUAL, AUTO POWER ON.
POWER LED turns on.
NO
17
Others
Check POWER Supplying Short.
YES
DMKEY LED turns on.
NO
Check +5V (DIG).
51
YES
IC8N (CPU) pin 64 is oscillated (6, 144 MHz).
NO
51
Check
X01 (12.288 MHz) C26, C27.
51
YES
IC8N (CPU) pin 7 RESET does not stay in L.
NO
Check +5V Voltage. (4.5V or more).
NO
17
Check +5V supply.
YES
Check IC9M
(Pin 6, 7 are > 1.23V?).
YES
LED of DMKEY turns on only at REAL.
NO
Condition does not charge replacing ROM.
NO
ROM is out of order.
YES
Check jamming of
51 DATA BUS (IC7L)
52 ADDRES BUS
53 (IC8M, 7M)
54 I/O DATA
41 BUS (IC2L)
YES
Name, Version, sensitivity, and SWEEP displaied.
NO
54
Remove both of P5401, 5402, and standing up again and can be Displaied.
NO
Strange CHARACTER appears.
NO
Go to Display Circuit.
YES
YES
YES
Check
58 GP-IB or
59 RS-232-C
51
Any of
IC8N (CPU)
Pin 9 (INT0)
Pin 10 (INT1)
Pin 11 (INT2)
Stays in L.
NO
J5101 is not connected well or jamming or DISPLAY PORTION
52
YES
Input and Output LOGIC of ICIE is right.
NO
IC IE is not good.
H

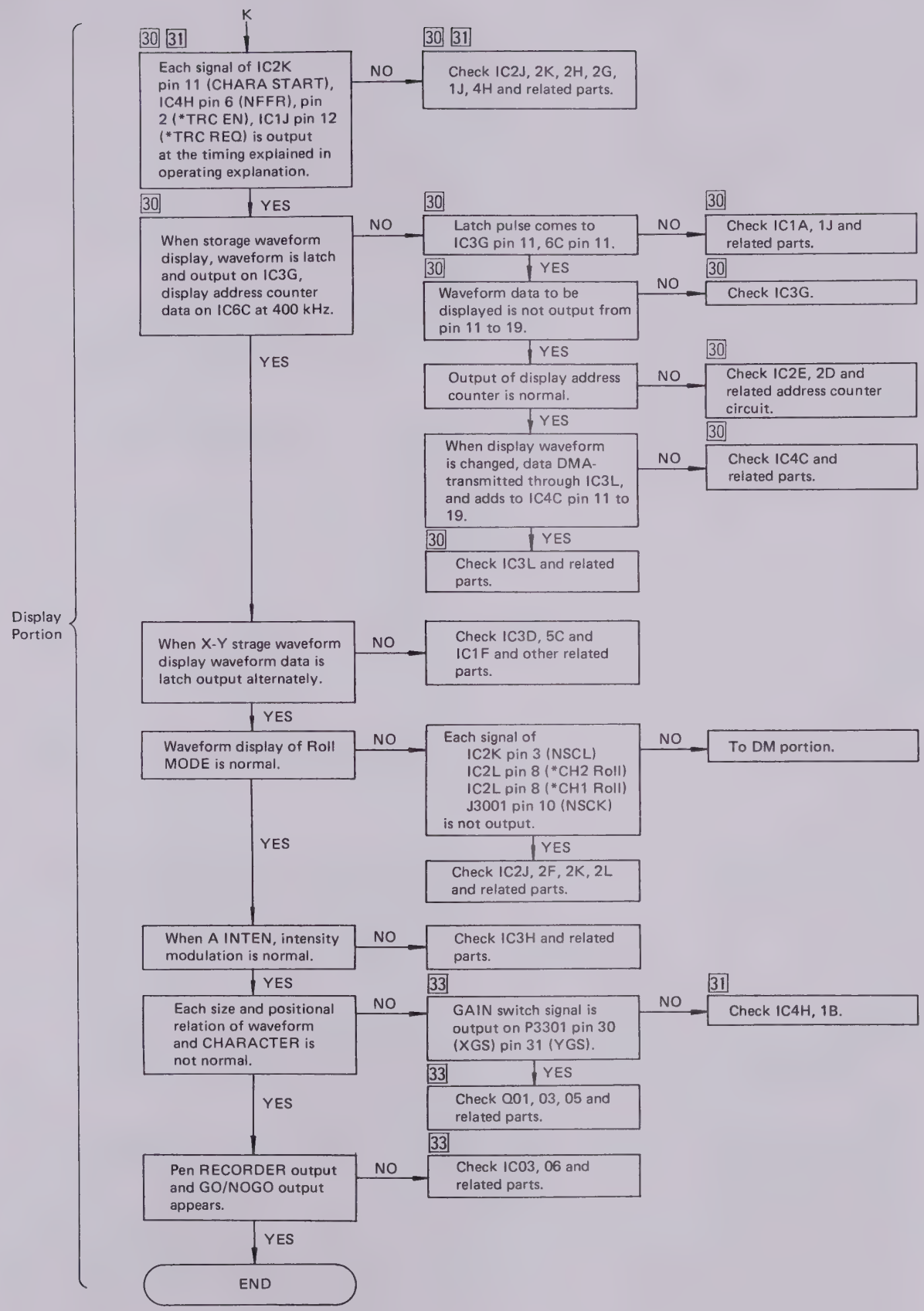

H
51
INT0 stays in L.
NO
INT1 stays in L.
NO
52
IS arround ICID, ICIF OK?
NO
To DM part or to Display.
54
YES
Check IC11N.
52
IC 2F pin 2 is L (*INTSS KEY).
NO
52
IC2F pin 3 is L (*INTDMKEY)
NO
52 53
Check IC2D, 2C 3N (*INTROTARY)
53
Check arround IC3E IC3L
53
YES
Check arround IC3K 3M
Key Operation Parts
Model name and version display soon disappears.
NO
Check REAL portion.
YES
51
At the condition that pressed SW1 and displaied model name and version, chaging V sensitivity V MODE, SWEEP speed, name and version CHARACTER dissappear.
NO
Check arround
53 IC 2E, 3E, 3A
53 connection of J5302
Circuit of 20 21
(*INTSS, *DREQ is not occured.)
After POWER ON, REMOTE LED turned on in INITIALIZE.
NO
YES
52
Check R5105 pull-up. check arround IC2J, 3K, 4L.
53
Check connection of J5302, arround IC2E 3E, 3A, and
20 21 CD026.
YES
Changing V sensitivity V MODE, and SWEEP speed. Display is changed.
NO
Sensitivity and SWEEP speed display is wrong (does not match with pannel setting).
NO
YES
Change is wrong.
NO
Check 20 21 CD026.
YES
Check 53 IC3A
21 IC09
51
Press SW1 and stand up again. Pressing CURKEY Model Name and Version disappear.
NO
Check
53 J5301 connection IC3M
55 (KEY-BOARD)
52 ICIE, 2F
YES
CURSOR Menu appears.
NO
Check
53 IC 3M
55 (KEY-BOARD)
YES


I
Rotary Encoder
CURSOR moves when pressing C1 and turning rotary encoder at ΔV mode.
NO
Output (A, B) LEBEL of rotary encoder is 2Vp-p or more.
NO
Rotary encoder is out of order 53 J5304, J5303 contact is bad.
YES
53
Pulse line appears on IC2N, pin 1, 7.
NO
Check IC2N.
YES
53
Check IC3N.
YES
Storage Operation
Continues to display taking waveform pressing Storage KEY.
NO
WRITE BUSY LED is blinking.
NO
52
Pulse comes to IC1C pin 3 TRCEN.
NO
To DM portion or to DISPLAY portion.
YES
YES
To DISPLAY portion.
YES
Trace can be seen up or down when STORAGE VARIABLE is minimum.
NO
To DISPLAY portion.
YES
Conditions are different at CH1 and 2.
NO
To DM portion.
35 36
YES
Remove DS-6612 35 J3501, J35201 each.
Remove DS-6411 36 J101, J201 each and connect to GND.
⇓
Similar condition happens.
NO
6
Remove J601, 602 each.
⇓
Similar condition happens.
NO
5
Check V. CONT circuit.
6
YES
Check A/D BUFF circuit.
35 36
YES
Check DS-6612 35 circuit
DS-6411 36 circuit.
YES
J

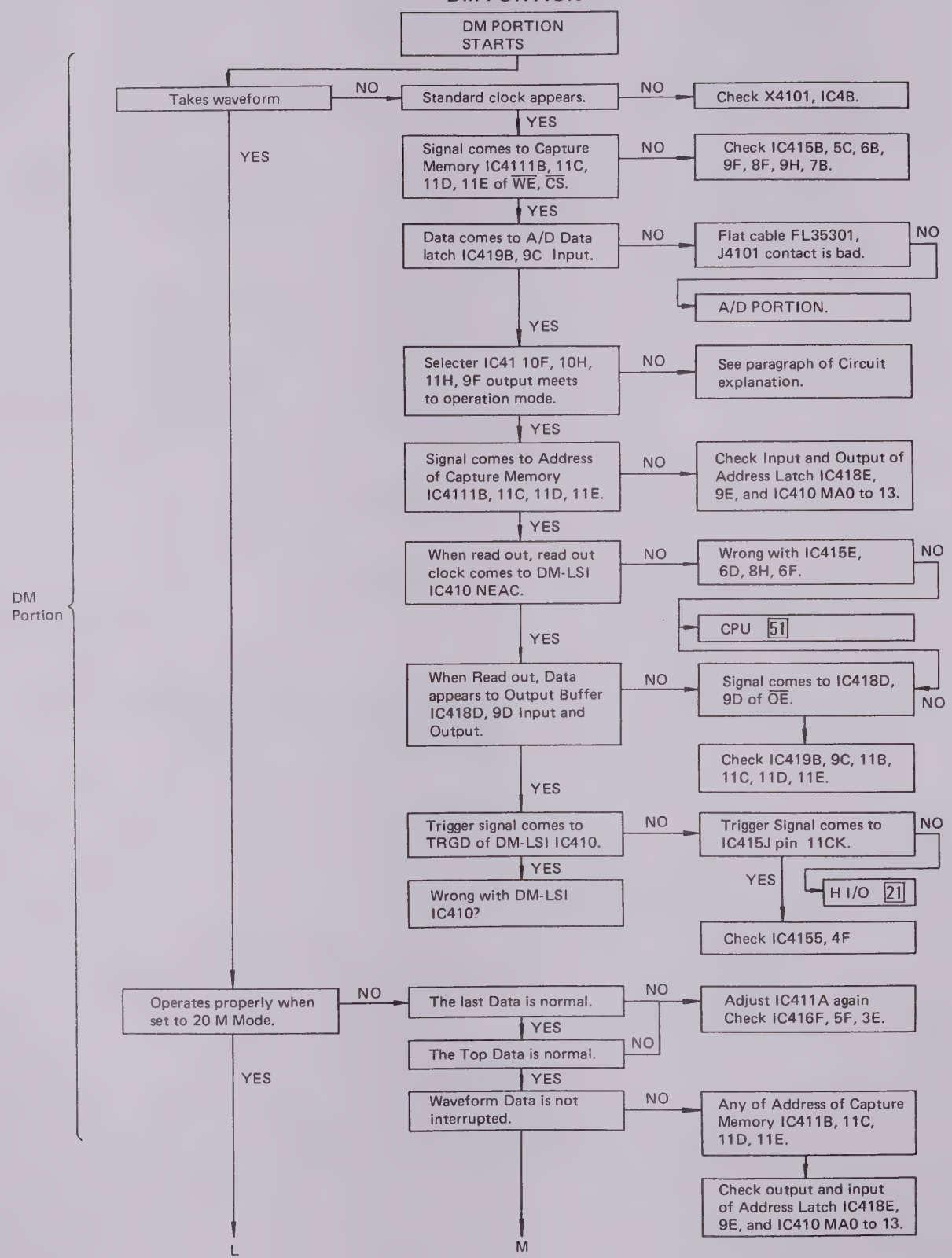

J
At SINGLE MODE SINGLE RESET is available.
NO
READY LED turns on.
NO
13
Check arround JC02 Q01
YES
13 9
Check arround
13 IC03, 02
9 IC03 or DM portion.
53 58 59
Check
53 arround IC2k, 4J
58 GP-IB circuit
59 RS-232-C circuit.
In the case of GP-IB RS-232-C attached, parameter setting item appears on menu.
NO
YES
Waveform taken at STORAGE has missing codes.
NO
Waveform vibrates
NO
Partically DISPLAY is skipped.
NO
END
YES
YES
To DM portion or AD portion.
YES
Skipped part is on the top or the bottom of CRT screw (Can be seen at STORAGE VARIABLE minimum.)
NO
To DISPLAY portion.
YES
To DM portion or DISPLAY portion.
35 36
Remove DS-6612 35 J35101, J35201 each.
Remove DS-6411 36 J101, J201 each and connect A/D side to GND
⇓
Similar condition happens.
NO
6
Remove J601, 602
⇓
Similar condition happens.
NO
5
Check V. CONT circuit.
6
YES
Check A/D BUFF circuit.
35 36
YES
Check DS-6612 35 circuit
Check DS-6411 36 circuit.

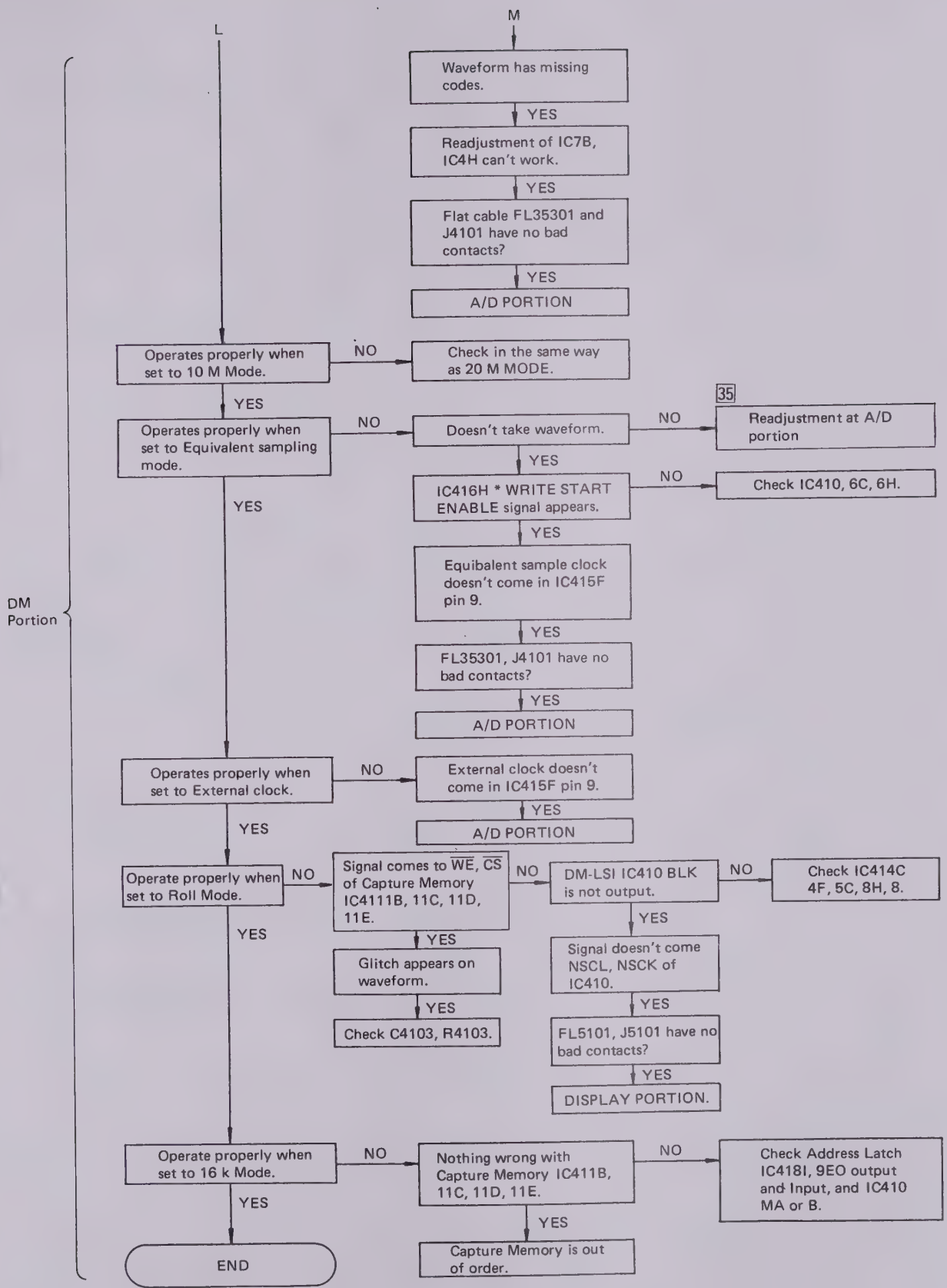
DISPLAY PORTION



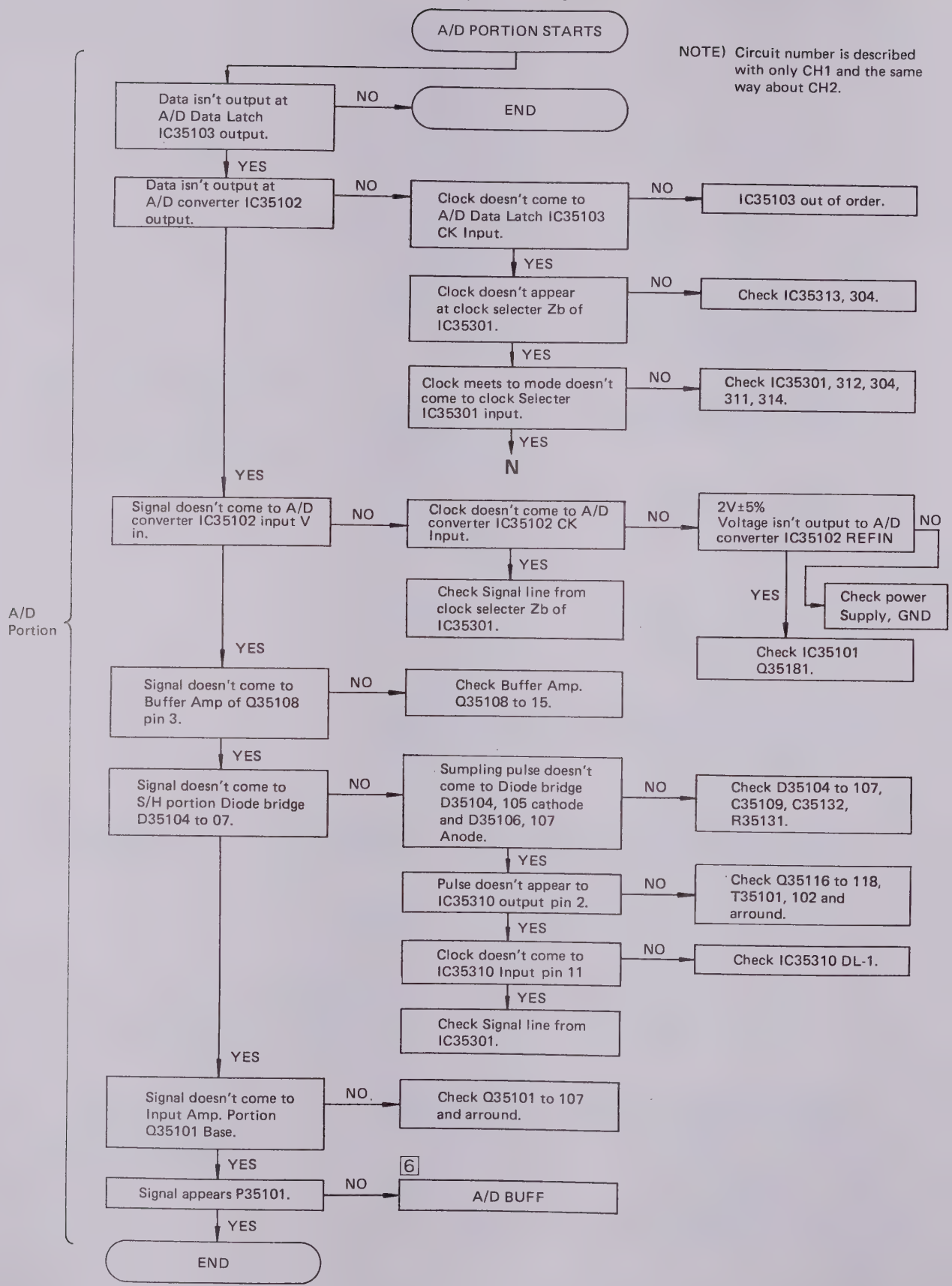

Display Portion
K
30 31
Each signal of IC2K pin 11 (CHARA START), IC4H pin 6 (NFFR), pin 2 (*TRC EN), IC1J pin 12 (*TRC REQ) is output at the timing explained in operating explanation.
NO
30 31
Check IC2J, 2K, 2H, 2G, 1J, 4H and related parts.
30
YES
When storage waveform display, waveform is latch and output on IC3G, display address counter data on IC6C at 400 kHz.
NO
30
Latch pulse comes to IC3G pin 11, 6C pin 11.
NO
30
Check IC1A, 1J and related parts.
30
YES
Waveform data to be displayed is not output from pin 11 to 19.
NO
30
Check IC3G.
YES
Output of display address counter is normal.
NO
30
Check IC2E, 2D and related address counter circuit.
YES
When display waveform is changed, data DMA-transmitted through IC3L, and adds to IC4C pin 11 to 19.
NO
30
Check IC4C and related parts.
30
YES
Check IC3L and related parts.
YES
When X-Y strage waveform display waveform data is latch output alternately.
NO
Check IC3D, 5C and IC1F and other related parts.
YES
Waveform display of Roll MODE is normal.
NO
Each signal of
IC2K pin 3 (NSCL)
IC2L pin 8 (*CH2 Roll)
IC2L pin 8 (*CH1 Roll)
J3001 pin 10 (NSCK)
is not output.
NO
To DM portion.
YES
Check IC2J, 2F, 2K, 2L and related parts.
YES
When A INTEN, intensity modulation is normal.
NO
Check IC3H and related parts.
YES
Each size and positional relation of waveform and CHARACTER is not normal.
NO
33
GAIN switch signal is output on P3301 pin 30 (XGS) pin 31 (YGS).
NO
31
Check IC4H, 1B.
33
YES
Check Q01, 03, 05 and related parts.
YES
Pen RECORDER output and GO/NOGO output appears.
NO
33
Check IC03, 06 and related parts.
YES
END

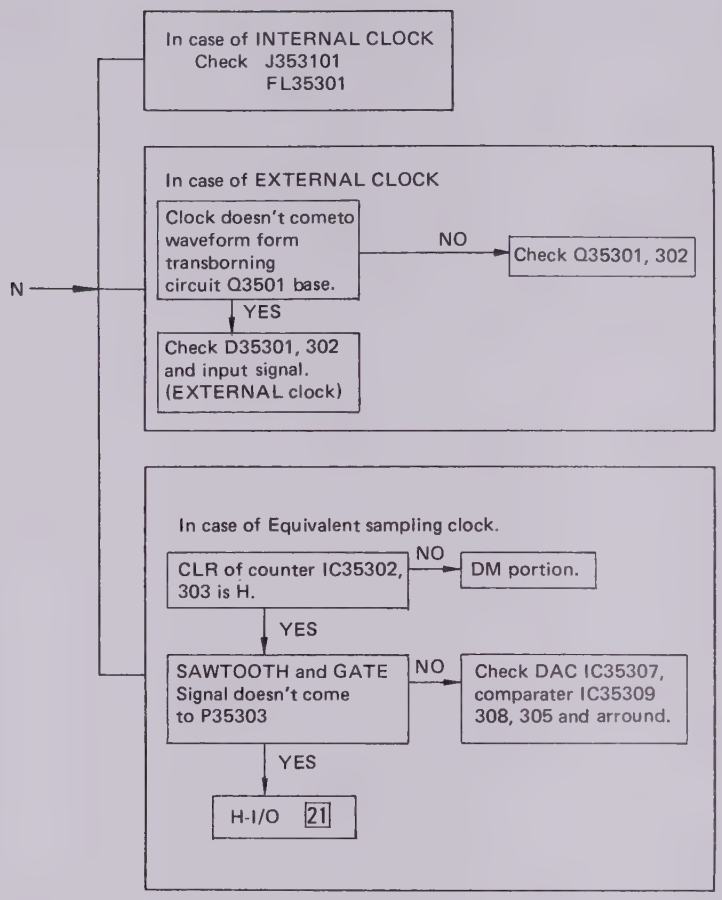
DM PORTION


DM PORTION STARTS
Takes waveform
NO
Standard clock appears.
NO
Check X4101, IC4B.
YES
YES
Signal comes to Capture Memory IC4111B, 11C, 11D, 11E of WE, CS.
NO
Check IC415B, 5C, 6B, 9F, 8F, 9H, 7B.
YES
Data comes to A/D Data latch IC419B, 9C Input.
NO
Flat cable FL35301, J4101 contact is bad.
NO
A/D PORTION.
YES
Selecter IC41 10F, 10H, 11H, 9F output meets to operation mode.
NO
See paragraph of Circuit explanation.
YES
Signal comes to Address of Capture Memory IC4111B, 11C, 11D, 11E.
NO
Check Input and Output of Address Latch IC418E, 9E, and IC410 MA0 to 13.
YES
When read out, read out clock comes to DM-LSI IC410 NEAC.
NO
Wrong with IC415E, 6D, 8H, 6F.
NO
CPU 51
YES
When Read out, Data appears to Output Buffer IC418D, 9D Input and Output.
NO
Signal comes to IC418D, 9D of OE.
NO
Check IC419B, 9C, 11B, 11C, 11D, 11E.
YES
Trigger signal comes to TRGD of DM-LSI IC410.
NO
Trigger Signal comes to IC415J pin 11CK.
NO
YES
Wrong with DM-LSI IC410?
YES
H I/O 21
Check IC4155, 4F
DM Portion
Operates properly when set to 20 M Mode.
NO
The last Data is normal.
NO
Adjust IC411A again Check IC416F, 5F, 3E.
YES
The Top Data is normal.
NO
YES
YES
Waveform Data is not interrupted.
NO
Any of Address of Capture Memory IC411B, 11C, 11D, 11E.
Check output and input of Address Latch IC418E, 9E, and IC410 MA0 to 13.
L
M


DM Portion
L
M
Waveform has missing codes.
YES
Readjustment of IC7B, IC4H can't work.
YES
Flat cable FL35301 and J4101 have no bad contacts?
YES
A/D PORTION
Operates properly when set to 10 M Mode.
NO
Check in the same way as 20 M MODE.
YES
Operates properly when set to Equivalent sampling mode.
NO
Doesn't take waveform.
NO
35
Readjustment at A/D portion
YES
IC416H * WRITE START ENABLE signal appears.
NO
Check IC410, 6C, 6H.
YES
Equibalent sample clock doesn't come in IC415F pin 9.
YES
FL35301, J4101 have no bad contacts?
YES
A/D PORTION
YES
Operates properly when set to External clock.
NO
External clock doesn't come in IC415F pin 9.
YES
A/D PORTION
YES
Operate properly when set to Roll Mode.
NO
Signal comes to WE, CS of Capture Memory IC4111B, 11C, 11D, 11E.
NO
DM-LSI IC410 BLK is not output.
NO
Check IC414C 4F, 5C, 8H, 8.
YES
YES
Glitch appears on waveform.
YES
Check C4103, R4103.
YES
Signal doesn't come NSCL, NSCK of IC410.
YES
FL5101, J5101 have no bad contacts?
YES
DISPLAY PORTION.
YES
Operate properly when set to 16 k Mode.
NO
Nothing wrong with Capture Memory IC411B, 11C, 11D, 11E.
NO
Check Address Latch IC418I, 9EO output and Input, and IC410 MA or B.
YES
YES
END
Capture Memory is out of order.

A/D PORTION


A/D PORTION STARTS
NOTE) Circuit number is described with only CH1 and the same way about CH2.
Data isn't output at A/D Data Latch IC35103 output.
NO
END
YES
Data isn't output at A/D converter IC35102 output.
NO
Clock doesn't come to A/D Data Latch IC35103 CK Input.
NO
IC35103 out of order.
YES
Clock doesn't appear at clock selecter Zb of IC35301.
NO
Check IC35313, 304.
YES
Clock meets to mode doesn't come to clock Selecter IC35301 input.
NO
Check IC35301, 312, 304, 311, 314.
YES
N
YES
Signal doesn't come to A/D converter IC35102 input V in.
NO
Clock doesn't come to A/D converter IC35102 CK Input.
NO
2V±5% Voltage isn't output to A/D converter IC35102 REFIN
NO
YES
Check power Supply, GND
Check IC35101 Q35181.
YES
Check Signal line from clock selecter Zb of IC35301.
YES
Signal doesn't come to Buffer Amp of Q35108 pin 3.
NO
Check Buffer Amp. Q35108 to 15.
YES
Signal doesn't come to S/H portion Diode bridge D35104 to 07.
NO
Sumpling pulse doesn't come to Diode bridge D35104, 105 cathode and D35106, 107 Anode.
NO
Check D35104 to 107, C35109, C35132, R35131.
YES
Pulse doesn't appear to IC35310 output pin 2.
NO
Check Q35116 to 118, T35101, 102 and arround.
YES
Clock doesn't come to IC35310 Input pin 11
NO
Check IC35310 DL-1.
YES
Check Signal line from IC35301.
YES
Signal doesn't come to Input Amp. Portion Q35101 Base.
NO
Check Q35101 to 107 and arround.
YES
Signal appears P35101.
NO
6
A/D BUFF
YES
END
A/D Portion


In case of INTERNAL CLOCK
Check J353101
FL35301
In case of EXTERNAL CLOCK
Clock doesn't cometo waveform form transborning circuit Q3501 base.
NO
Check Q35301, 302
YES
Check D35301, 302 and input signal. (EXTERNAL clock)
N
In case of Equivalent sampling clock.
CLR of counter IC35302, 303 is H.
NO
DM portion.
YES
SAWTOOTH and GATE Signal doesn't come to P35303
NO
Check DAC IC35307, comparater IC35309 308, 305 and arround.
YES
H-I/O 21

MEMO

Section 4 Check and Adjustment

4-1 GENERAL

Correct measurement requires the normal operation of each circuit in DS-6612/DS-6411 and satisfactory maintenance of their performance.

With the regular performance check and adjustment, DS-6612/DS-6411 can develop its functions in a reliable manner for a long period of service.

This section describes the appropriate method of check and adjustment.

4-2 PERIOD OF CHECK AND ADJUSTMENT

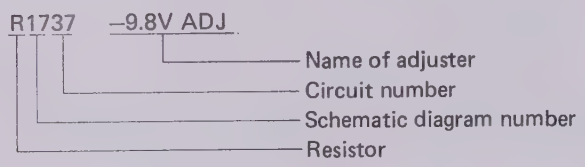
The regular and periodical check and adjustment of performance is necessary for correct measurement. The proper check intervals for DS-6612/DS-6411 are six months.

4-3 PRECAUTIONS FOR CHECK AND ADJUSTMENT

For the performance check and adjustment, pay attention to the followings.

1. Some signal generator outputs at a 50Ω termination; so using a control cable with characteristic impedance of 50Ω (e.g. BB-120 by Iwatsu), terminate the cable end at the scope with a 50Ω terminator (e.g. BB-50M1 by Iwatsu).
2. The low-voltage power is supplied to all circuits. If its voltage or ripple goes outside the specified values, the other performance will be affected. If check and adjustment, therefore, check the low-voltage power supply first.
3. The CRT has a high-voltage. For its check and adjustment, be careful not to catch an electric shock.
4. An adjuster used for checking and adjustment has the following indication number.

Example



The above number specifies the 17th circuit diagram and 37th resistor. [17] is displayed [17] on a printed circuit board as well as in a schematic diagram.

4-4 EQUIPMENT REQUIRED

The check and adjustment requires the equipment and accessories as described in Table 4-4-1. The equipment have the performance equal to or greater than those described in the table.

The signal connector of DS-6612/DS-6411 is BNC. If the terminator or signal output terminal is other than BNC, prepare a converter connector.

Table 4-4-1. List of Equipment Required

Equipment	Minimum Specifications	Purpose	Recommended Model
1. Scope calibrator • Calibration voltage generator Output voltage • Time-mark generator Repetition time • Sine wave generator Repetition frequency • Square wave generator Repetition frequency Rise time	 0.12 mV to 60V Accuracy: ±0.5% or less 20 ns to 2 s Accuracy: ±5% or less 1 kHz Accuracy: ±20% or less 50 Hz to 200 kHz 5 ns or less	Vertical, triggering, and horizontal checks and adjustments	Iwatsu SC-340
2. Fast rise square wave generator Repetition frequency Rise time	 50 Hz to 200 kHz 1 ns or less	Vertical checks	Iwatsu PG-10P
3. Standard signal generator Repetition frequency Output voltage	 50 kHz to 250 MHz 60 mV or more	Pattern distortion, bandwidth and phase difference (on X-Y operation) checks and adjustments	
4. Function generator Repetition frequency Output voltage	 DC to 10 MHz 1V or more	Vertical checks	Iwatsu FG-350
5. Digital volt-meter Range	 DC volt range to 200V dc Accuracy: ±0.2% + dgt.	Low-voltage power supply checks and adjustments	Iwatsu SC-7401
6. High-voltage probe Range	 DC volt range to 20 kV dc Accuracy: ±3% + 1 dgt.	CRT cathode voltage checks and adjustment	High-voltage probe (Iwatsu SC-7401 option)

Table 4-4-1. List of Equipment Required (Cont.)

Equipment	Minimum Specifications		Purpose	Recommended Model
7. Test oscilloscope Bandwidth Minimum deflection	Minimum Specifications	DC to 100 MHz 5 mV ~ 5V/div	Low-voltage power supply checks and adjustments	Iwatsu SS-5711
	Oscilloscope 1 DC to 1 kHz 1mV/div			
	Oscilloscope 2 DC to 100 MHz 5mV ~ 5V/div			
8. Oscilloscope probe Attenuation ratio	1 : 1		Low-voltage power supply checks and adjustments	Iwatsu SS-0001 to 3
9. Frequency counter Range Resolution	10 Hz to 1.5 MHz		Calibration voltage checks and adjustments	Iwatsu SC-7101
10. Voltage regulator			AC line voltage range check	
11. Termination (2 required) Impedance	50Ω		Signal termination	Iwatsu BB-50M1
12. 6 dB divider			Input signal inter-connection	Iwatsu B-50D3
13. Coaxial cable (3 required) Impedance Length	50Ω 1.2 m		Signal input	Iwatsu BB-120C
14. Accessory probes Attenuation ratio	10 : 1		Signal input	Iwatsu SS-0011R (DS-6612) SS-066R (DS-6411)
15. Screwdriver (Probe accessory)			Adjust variable resistors and capacitors	
16. Attenuator				

4-5 CHECK AND ADJUSTMENT ITEMS

The check and adjustment items are shown in Table 4-5-1.

Table 4-5-1. Items and Interactions

Order	Checks and Adjustment Items		Page
	——— Power Supply, CRT and calibrator output ———		
1	4-7-1	Power Supply	4-12
2	4-7-2	AC Voltage Range	4-13
3	4-7-3	CRT Cathode Voltage	4-14
4	4-7-4	Intensity	4-15
5	4-7-5	Focus	4-16
6	4-7-6	The Parallel of the Horizontal Trace and Horizontal Scale	4-17
7	4-7-7	Pattern Distortion	4-18
8	4-7-8	Calibrator Output : Output Voltage : Repetition Rate	4-19
	——— Vertical Deflection System ———		
10	4-8-1	X5 MAG and Vertical Balance	4-21
11	4-8-2	GAIN	4-22
12	4-8-3	Attenuator Compensation	4-24
13	4-8-4	Square Wave Characteristics	4-26
14	4-8-5	Band width	4-28
15	4-8-6	Linearity	4-29
	——— Triggering ———		
16	4-9-1	A Trigger	4-31
	——— Horizontal Deflection Systems ———		
17	4-10-1	Magnifier Center	4-34
18	4-10-2	A Sweep Time	4-35
19	4-10-3	X10 A Sweep Time	4-36
20	4-10-4	A Sweep Length	4-37
21	4-10-5	A, B Sweep Start Point	4-38
22	4-10-6	B Sweep (Start and Stop)	4-39
23	4-10-7	X-Y Gain • Position	4-40
	——— Cursor and A/D Converter ———		
24	4-11-1	Horizontal Cursor	4-42
25	4-11-2	Vertical Cursor	4-43
26	4-11-3	Stable of Characters	4-44
27	4-11-4	A/D Offset, Gain and Position	4-45
28	4-11-5	Square Wave Characteristics (Storage Mode)	4-46
29	4-11-6	Band width (Storage Mode)	4-47
30	4-11-7	Equ-sampling (Start and Stop)	4-48
31	4-11-8	X10 MAG (Storage)	4-49

4-6 PREPARATION

4-6-1 Before Making Check and Adjustment, Prepare

1. Set the ambient temperature at 23°C±5°C.
2. Set the voltage switch on the rear panel to meet the line voltage. Connect the power cord to the plug socket of the line. If the line voltage is outside the operating range of DS-6612/DS-6411, set the voltage within the range using a voltage regulator.
3. Turn POWER switch on to supply power, adjust A INTEN to provide the proper intensity and trace, and keep the condition for about 30 minutes to warm up the machine.

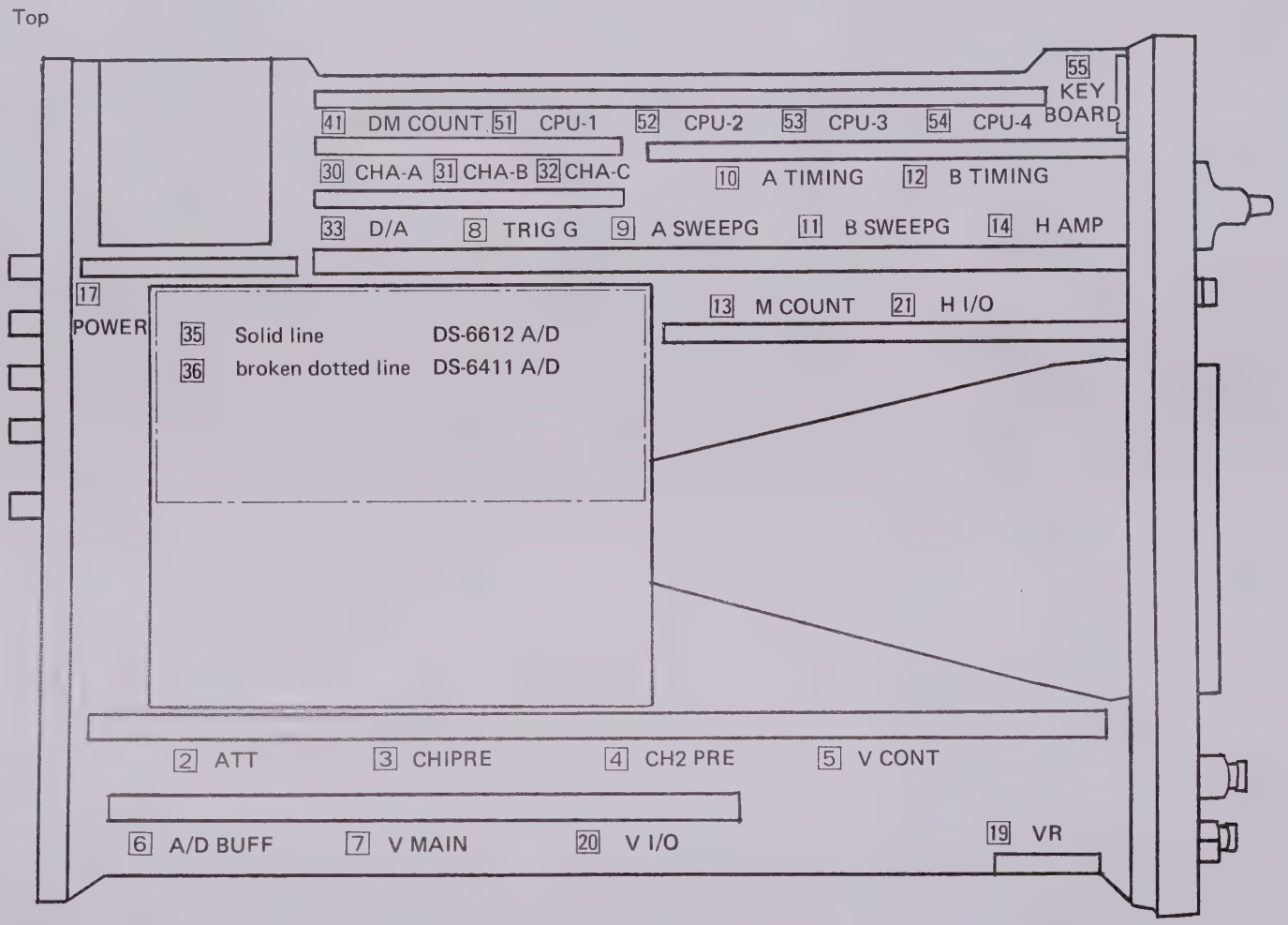
4-6-2 Printed Circuit Board Locations

Printed circuit board locations are described in Figure 4-6-1 and 4-6-2 (page 4-6 to 4-9).

4-6-3 Check-points and Adjuster Locations

Check-points necessary for checks and adjustments as well as the adjuster location are described in Figure 4-7-1 to 4-11-8.

Figure 4-6-1. Printed Circuit Board Locations (I)



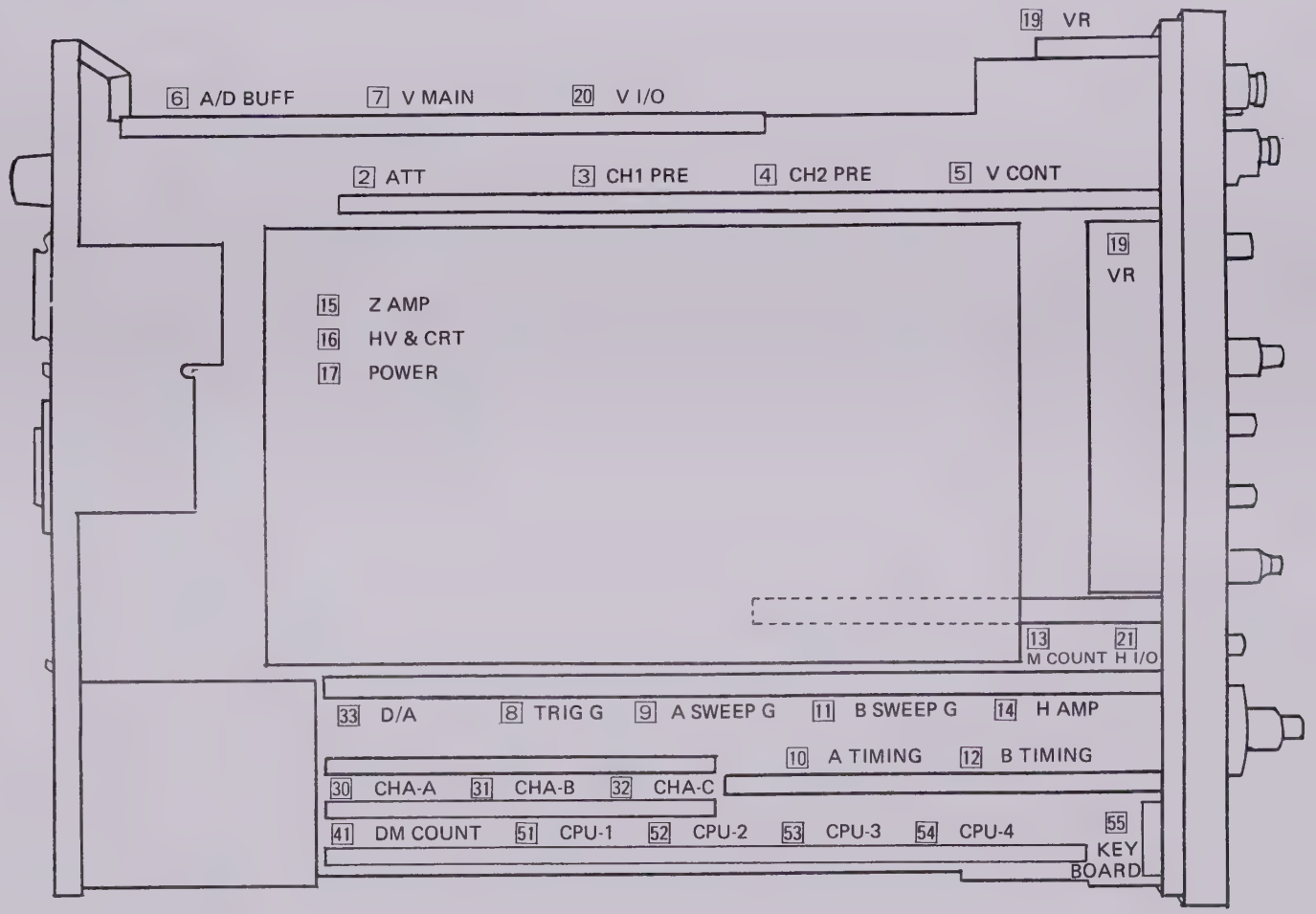
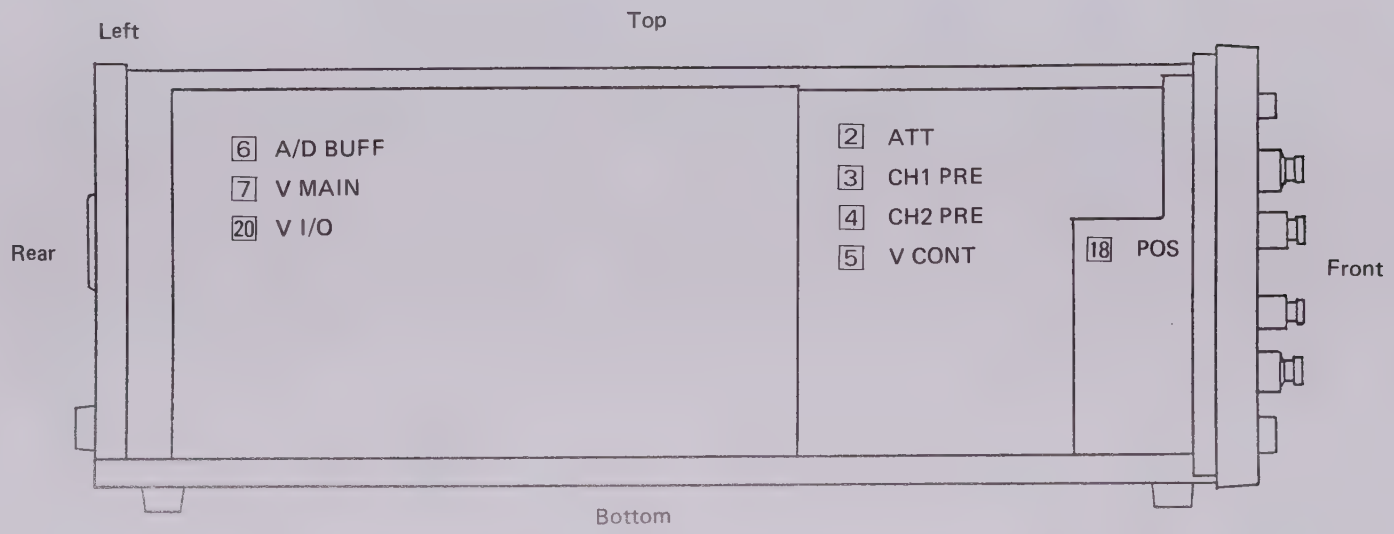
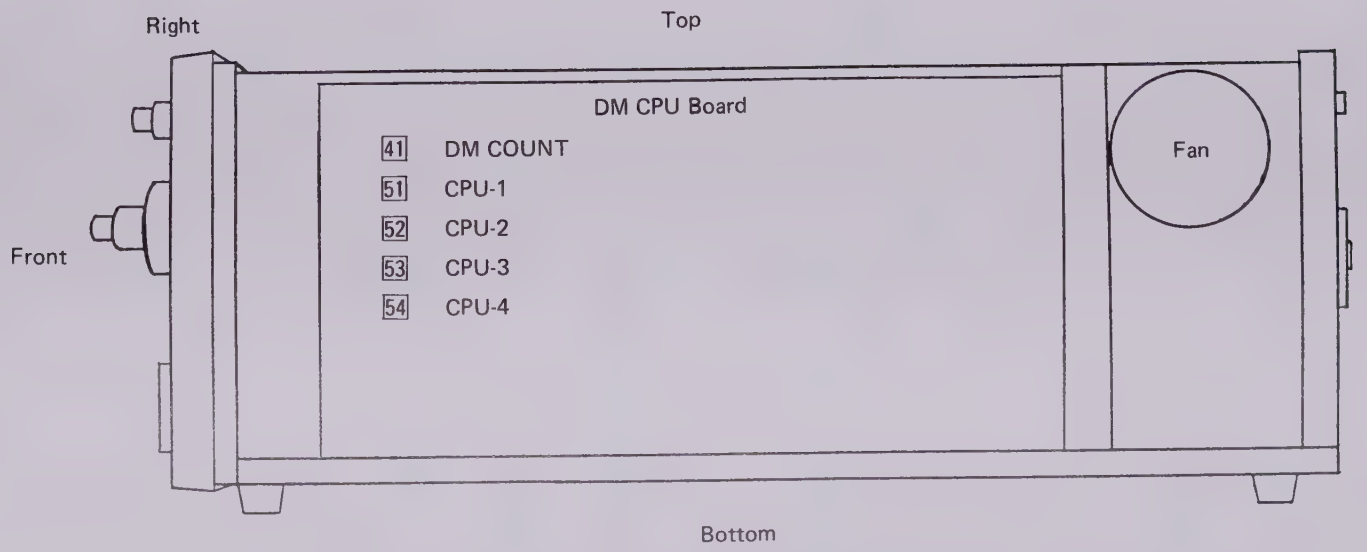

19 VR
6 A/D BUFF
7 V MAIN
20 V I/O
2 ATT
3 CH1 PRE
4 CH2 PRE
5 V CONT
19
VR
15 Z AMP
16 HV & CRT
17 POWER
13
M COUNT
21
H I/O
33 D/A
8 TRIG G
9 A SWEEP G
11 B SWEEP G
14 H AMP
10 A TIMING
12 B TIMING
30 CHA-A
31 CHA-B
32 CHA-C
41 DM COUNT
51 CPU-1
52 CPU-2
53 CPU-3
54 CPU-4
55
KEY
BOARD

Figure 4-6-2. Printed Circuit Board Locations (II)

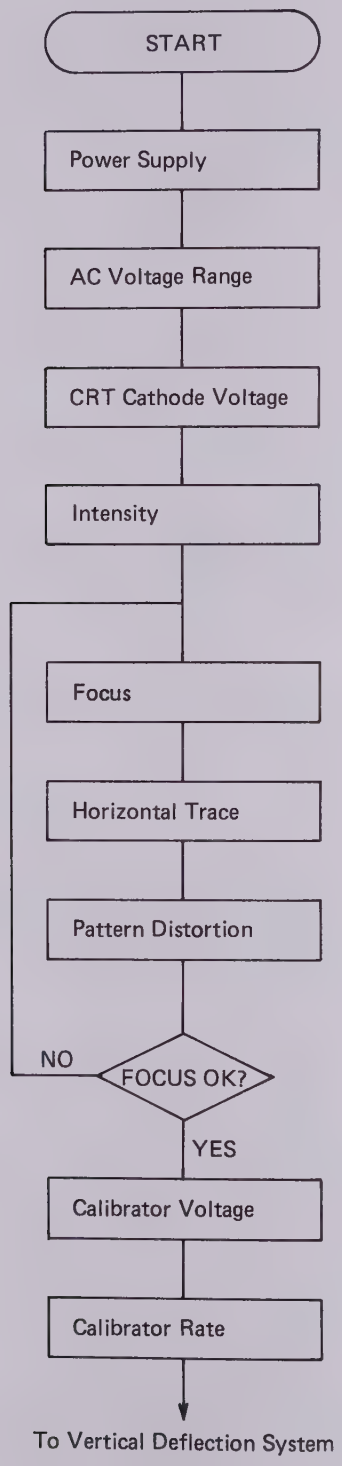



Right
Top
DM CPU Board
41 DM COUNT
51 CPU-1
52 CPU-2
53 CPU-3
54 CPU-4
Fan
Front
Bottom

List of Figures

		Page
4-7-1	Power Supply 17	4-12
4-7-2	Same as 4-7-1	
4-7-3	HV & CRT 16	4-14
4-7-4	Same as 4-7-3	
4-7-5	Same as 4-7-3	
4-7-6	VR 19	4-17
4-7-7	HV & CRT 16	4-18
4-7-8	V CONT 05	4-19
4-7-9	Same as 4-7-8	
4-8-1	CH1 PRE 03 , CH2 PRE 04	4-21
4-8-2	CH1 PRE 03 , CH2 PRE 04 , V CONT 05	4-22
4-8-3	ATT 02 , CH1 PRE 03	4-24
4-8-4	CH1 PRE 03 , CH2 PRE 04 , V CONT 05 , V MAIN 07 , TRIG G 08	4-26
4-8-5	CH1 PRE 03 , CH2 PRE 04	4-28
4-8-6	CH1 PRE 03 , CH2 PRE 04 , V CONT 05 , V MAIN 07	4-29
4-9-1	CH1 PRE 03 , CH2 PRE 04 , TRIG G 08 , M COUNT 13	4-31
4-10-1	H AMP 14	4-34
4-10-2	A SWEEP G 09 , B SWEEP G 11 , B TIMING 12 , H AMP 14	4-35
4-10-3	H AMP 14	4-36
4-10-4	A SWEEP G 09	4-37
4-10-5	B SWEEP G 11	4-38
4-10-6	M COUNT 13	4-39
4-10-7	Same as 4-10-6	
4-11-1	V MAIN 07	4-42
4-11-2	H AMP 14	4-43
4-11-3	Same as 4-11-1	
4-11-4	A/D BUFF 06 , A/D 35	4-45
4-11-5	Same as 4-11-4	
4-11-6	Same as 4-11-4	
4-11-7	A/D 35	4-48
4-11-8	Same as 4-11-2	

4-7 POWER SUPPLY · CRT · CALIBRATOR OUTPUT



	R1737 –9.8V ADJ	(4-7-1)
		(4-7-2)
	R1608 HV ADJ –1750V	(4-7-3)
	R1611 INTEN ADJ	(4-7-4)
	R1621 ASTIG	(4-7-5)
	R1906 TRACE ROTATION	(4-7-6)
	R1623 PDS	(4-7-7)
	R0573 CAL ADJ	(4-7-8)
		(4-8-9)

4-7 POWER SUPPLY · CRT and Calibrator Output

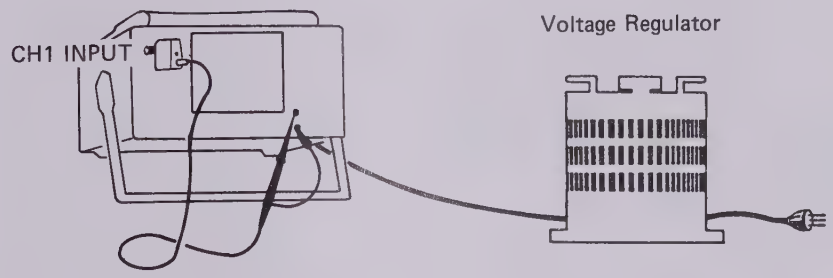
4-7-1 Power Supply

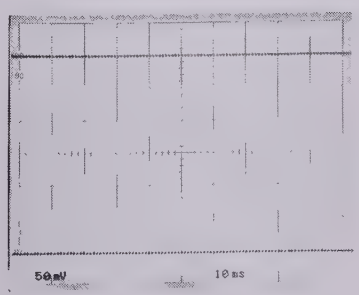
<table>
<tr><td>Item</td><td colspan="4">Description</td></tr>
<tr><td>Rating and check points</td><td colspan="4"><table>
<tr><th>DC Power Voltage</th><th>Ripple Voltage (p-p)</th><th>Adjuster</th><th colspan="2">Check Points</th></tr>
<tr><td>−9.8 ± 0.05V</td><td>0.5mV</td><td rowspan="8">R1737</td><td rowspan="7">Main board</td><td>J0521 pin 35, 36</td></tr>
<tr><td>−5 ± 0.25V</td><td>3mV</td><td>P1723 pin 5</td></tr>
<tr><td>+5 ± 0.25V</td><td>3mV</td><td>J0521 pin 31, 32</td></tr>
<tr><td>+9.8 ± 0.15V</td><td>0.5mV</td><td>J0521 pin 33, 34</td></tr>
<tr><td>+49 ± 1.0V</td><td>1mV</td><td>J0521 pin 39</td></tr>
<tr><td>+117.6 ± 4.8V</td><td>2mV</td><td>D1718 cathode</td></tr>
<tr><td>Digital
+5 ± 0.25V</td><td>—</td><td>DM CPU board</td><td>J5102 pin 3, 4</td></tr>
</table></td></tr>
<tr><td>Check and adjustment</td><td colspan="4">——— DC level ———
1. Check the voltage across the check points and the ground, using a digital multimeter.
2. If the voltage is outside the rated value, adjust "−9.8V" with R1737.
3. Check voltages at other locations again.

< Note >
The design is such that by adjusting −9.8V, other voltages can be set within the specification range.

——— Ripple Voltage ———
4. Set the sweep MODE to SINGLE.
5. Connect 1 : 1 probe with a test oscilloscope and check the ripple voltages of each power supply.</td></tr>
<tr><td>Check points and adjuster locations</td><td colspan="4">R1737 −9.8V ADJ Figure 4-7-1.</td></tr>
</table>

4-7-2 AC Voltage Range

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Rating</td><td>
<table>
<tr><th>Set Position</th><th>Center Voltage</th><th>Voltage Range</th><th>Fuse Spec</th></tr>
<tr><td>A</td><td>100V</td><td>90 to 110V</td><td rowspan="2">2A
Slow-blow</td></tr>
<tr><td>B</td><td>115V</td><td>103 to 128V</td></tr>
<tr><td>C</td><td>220V</td><td>195 to 242V</td><td rowspan="2">1A
Slow-blow</td></tr>
<tr><td>D</td><td>230V
240V</td><td>207 to 250V</td></tr>
</table>
</td></tr>
<tr><td>Connection</td><td>


CAUTION
The probe showin in this Figure is for the DS-6612.
</td></tr>
<tr><td>Setting</td><td>A SEC/DIV: 10 ms/div
CH1 VOLTS/DIV: 50 mV/div</td></tr>
<tr><td>Check</td><td>Using a voltage regulator, change the supply voltage level continuously and check that ripple or intensity modulation does not appear on the CRT waveform.
CAUTION
Before changing over a voltage range or replacing the fuse, be sure to remove a power cord plug from a plug socket.
</td></tr>
<tr><td>CRT waveform</td><td>Normal Wave form


</td></tr>
</table>

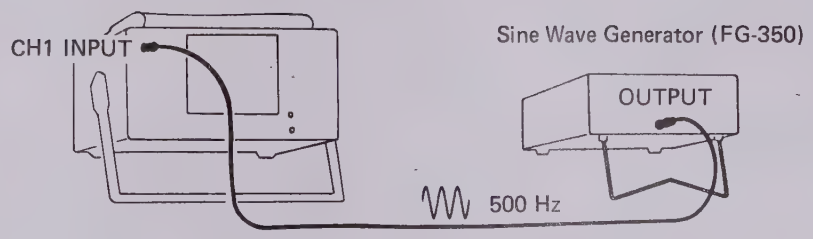
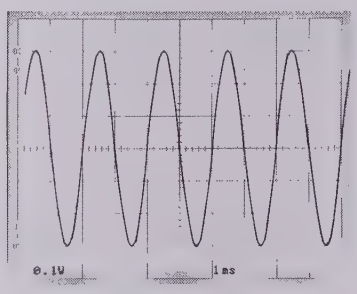
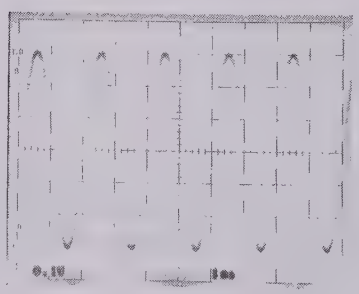
4-7-3 CRT Cathode Voltage

Item	Description
Rating	−1750V ±5%
Check and adjustment	1. Using a digital multimeter (with a high-voltage probe), measure the voltage either between connector P1602 Pin 3 and the ground. 2. If the result is outside the rated value, adjust the voltage with R1608HV ADJ. **CAUTION** *If the error of the CRT cathode voltage is within ±5%, do not make adjustment, except when all items are adjusted.*
Check point and adjuster locations	R1608 Figure 4-7-1.

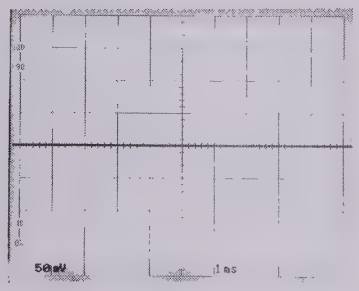
4-7-4 Intensity

Item	Description
Rating	The trace and the character are appropriate brighted when INTEN and READOUT INTEN control are turned half counterclockwise. The trace and the character are extinguished when INTEN and READ OUT INTEN control are turned fully counterclockwise.
Setting	HORIZ DISPLAY : A HORIZ MODE : AUTO A SEC/DIV : I ms/div
Check and adjustment	1. The trace and the character are appropriate brighted when INTEN and READ OUT INTEN control are turned half counterclockwise. The trace and the character are extinguished when INTEN and READ OUT INTEN control are turned fully counterclockwise. 2. Adjust with R1611 INTEN ADJ so that the trace can appear faintly by turning INTEN 60 degree from counterclockwise. 3. Verify that the character can appear faintly when READ OUT INTEN control are turned half counterclockwise. 4. Verify that the character are extinguished when READ OUT INTEN control are turned full counterclockwise.
CRT waveform	
Adjuster locations	R1611 INTEN ADJ Figure 4-7-1.

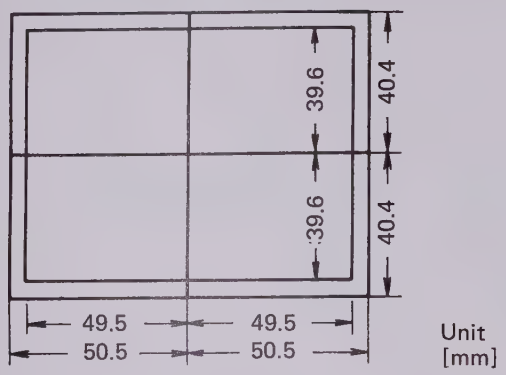
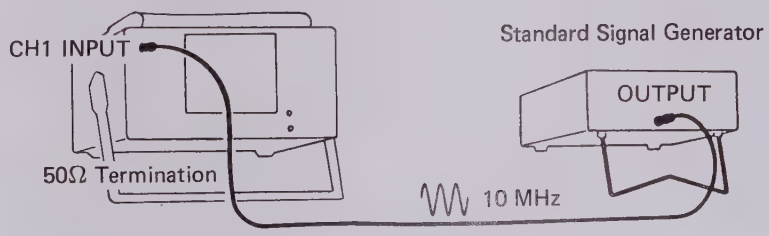
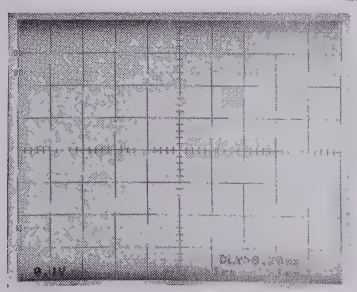
4-7-5 Focus

Item	Description
Rating	Adjust to minimize the effect on focus by turning A INTEN. Adjust focus to the best setting within 60° of midrange.
Connection	
Setting	INTEN : appropriate bright A SEC/DIV : 1 ms/div FOCUS : Midrange
Check and adjustment	1. Set the amplitude swings 6 divisions. 2. Verify that the Focus are best setting when FOCUS control are turned within 60° of mid-range. 3. Adjust with FOCUS and R1621 ASTIG so that the optimum focus can obtain.
CRT waveform	Appropriate Focus  Inappropriate Focus 
Adjuster locations	R1621 ASTIG Figure 4-7-1.

4-7-6 The Parallel of the Horizontal Trace and the Horizontal Scale (TRACE ROTATION)

Item	Description
Rating	The horizontal trace and the central horizontal scale line should meet each other.
Setting	INPUT : GND HORIZ DISPLAY : AUTO
Check and adjustment	1. Verify that the horizontal trace and the horizontal scale line meet by turning R1906 TRACE ROTATION on the front panel.
CRT waveform	
Adjuster locations	R1906 TRACE ROTATION Figure 4-7-1.

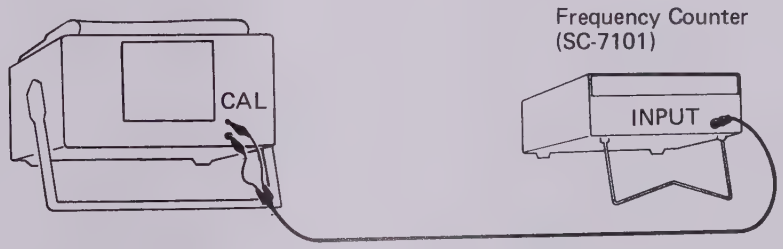
4-7-7 Pattern Distortion

Item	Description
Rating	should be within the range shown in the figure at the right. 
Connection	
Setting	HORIZ DISPLAY : A INTEN A SEC/DIV : 1 ms/div B SEC/DIV : 20 ns/div HOLDOFF : B ENDS A
Check and adjustment	1. Check the horizontal deflection on the top and bottom of the scale. 2. Check the vertical deflection on the left and the right end of the scale. 3. If the result is outside the rating, adjust with R1623 PDS.
CRT waveform	
Adjuster locations	R1623 PDS Figure 4-7-1.

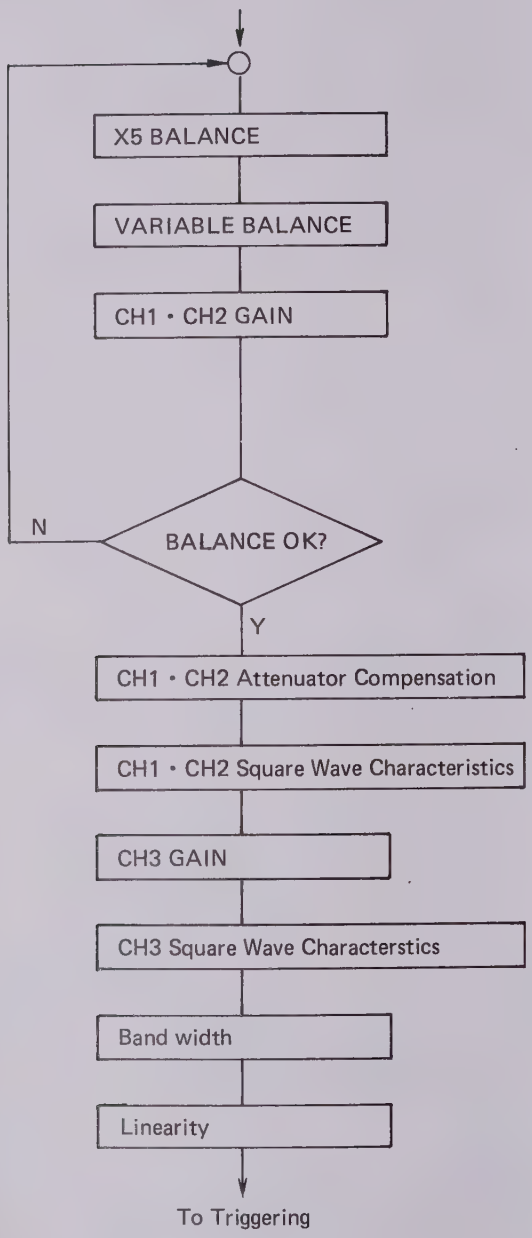
4-7-8 Calibrator Output Voltage

Item	Description
Rating	+0.3V ± 1%
Check and adjustment	1. Check the CAL (calibration voltage output terminal) voltage with test oscilloscope. 2. Adjust CAL (calibration voltage output terminal) voltage with R0573 CAL ADJ.
Connector and adjuster locations	R0573 CAL ADJ Figure 4-7-1.

4-7-9 Calibrator Output Repetition Rate

Item	Description
Rating	1 kHz ± 1%
Connection	
Check	1. Check CAL (calibration voltage output terminal) frequency with a counter.

4-8 VERTICAL DEFLECTION SYSTEM



R0321	CH1 ATTEN BAL	(4-8-1)
R0421	CH2 ATTEN BAL	(4-8-1)
R0352	CH1 VAR BAL	(4-8-1)
R0452	CH2 VAR BAL	(4-8-1)
R0364	CH1 X1 GAIN	(4-8-2)
R0464	CH2 X1 GAIN	(4-8-2)
R0337	CH1 X5 GAIN	(4-8-2)
R0437	CH2 X5 GAIN	(4-8-2)

ATT, PROBE (4-8-3)

C0313 C0413
R0560 C0521 (4-8-4)
R0766 C0707

R0533 CH3 GAIN (4-8-2)

R0535 (4-8-4)
C0516

(4-8-5)

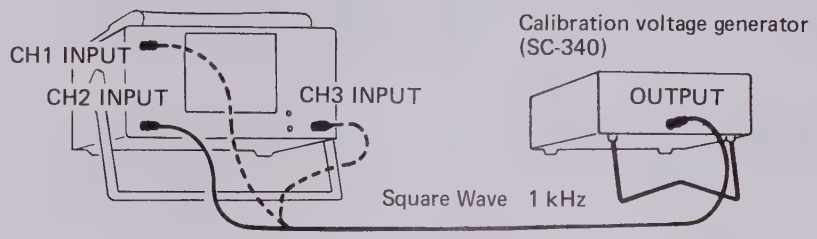
(4-8-6)

4-8 VERTICAL DEFLECTION SYSTEM

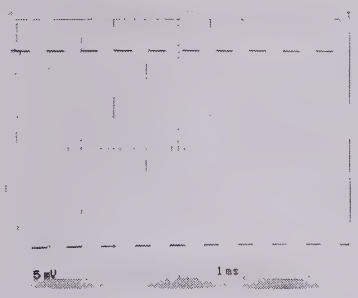
4-8-1 X5 Balance and Variable Balance

Item	Description
Setting	VOLTS/DIV : 5 mV/div
Check and adjustment	1. Adjust with R0321 CH1 ATTEN BAL and R0421 CH2 ATTEN BAL so that the Trace does not move when X5 MAG are pulled. 2. Adjust with R0352 and R0452 VAR BAL so that the trace does not move when VARIABLE are turned.
Adjuster locations	R0321 CH1 ATTEN BAL, R0421 CH2 ATTEN BAL, R0352 and R0452 VAR BAL Figure 4-7-2.

4-8-2 GAIN

Item	Description
Rating	Channel / RANGE / AMPLITUDE CH1 · CH2 / 1 mV/div, 2 mV/div / 6 div±4% 5 mV/div / 6 div±2% 10 mV/div to 10V/div / 6 div±2% CH3 / 0.1V/div / 6 div±3%
Connection	
Setting	A SEC/DIV : 1 kHz/div
Check and adjustment	CH1 and CH2 ——— **5 mV/div** ——— 1. Set the output of a calibration voltage generator to 30 mV. 2. Adjust the CRT amplitude to 6 div with R0364 **CH1 X1 GAIN** and R0464 **CH2 X1 GAIN.** ——— **1 mV/div** ——— 3. Set the output of a calibration voltage generator to 6 mV. 4. Adjust the CRT amplitude to 6 div with R0337 CH1 X5 GAIN and R0437 CH2 X5 GAIN. ——— **Other ranges** ——— 5. Adjust the output of a calibration voltage generator and check other ranges. **CAUTION** *The design is such that by adjusting 1 mV/div and 5 mV/div, other ranges can be set within the specification range.* CH3 6. Set the output of a calibration voltage generator to 0.6V. 7. Adjust the CRT amplitude to 6 div with R0533 CH3 GAIN.

4-8-2 GAIN (cont.)

Item	Description
CRT waveform	
Adjuster locations	R0337 CH1 x 5 GAIN, R0437 CH2 x 5 GAIN and R0464 CH2 x 1 GAIN Figure 4-7-2. R0364 CH1 x 1 GAIN Figure 4-7-3. R0533 CH3 GAIN Figure 4-7-4.

4-8-3 Attenuator Compensation

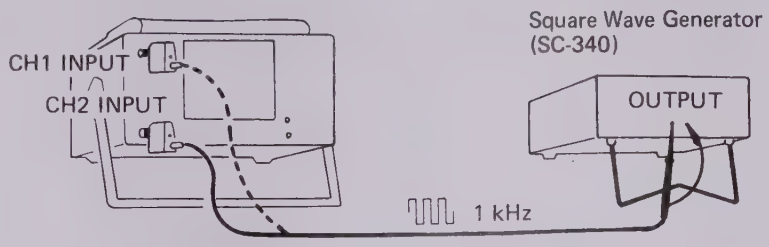
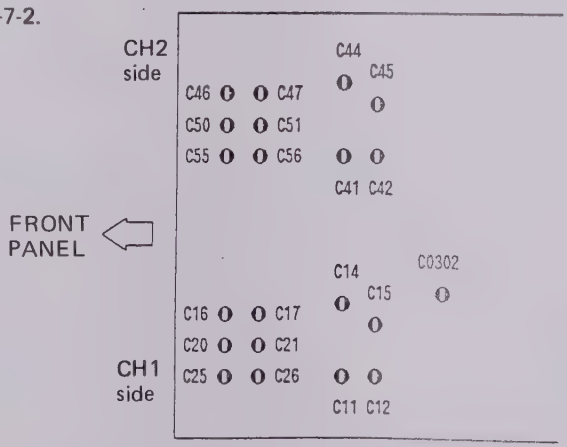
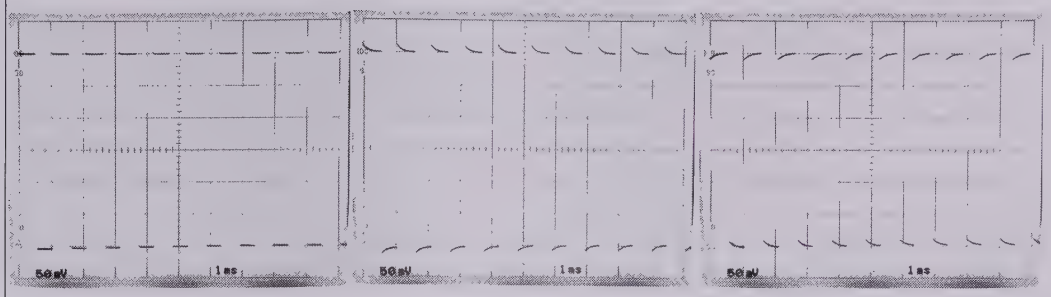
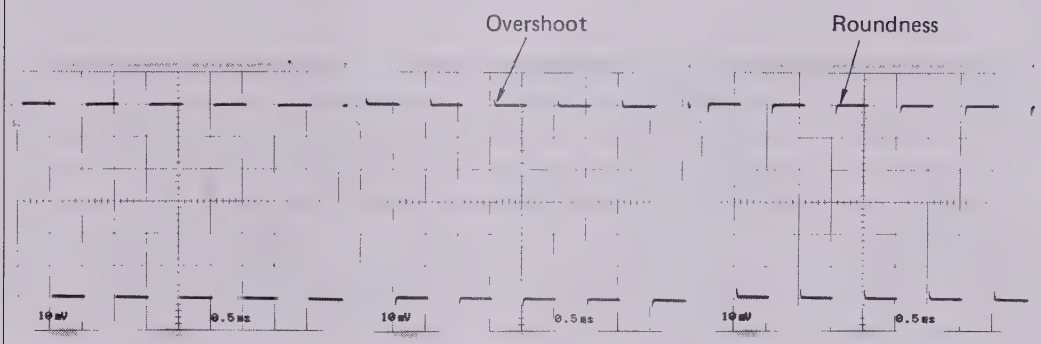
Item	Description
Connection	
Setting	CH1 · CH2 COUPL : DC Square Wave Generator output: Used probe (1 kHz)
Check and adjustment	1. Setting to CH2 5 mV/div, adjust flatness of the waveform, with probe. This probe is used for following adjustment. Further adjustment of probe is not performed after this operation. 2. Adjust flatness of the waveform with capacitor (1) to (5) of Figure 4-8-3. 3. Adjust flatness of the waveform with capacitor (6) to (11) of Figure 4-8-3.
Adjuster locations	Figure 4-7-2. 

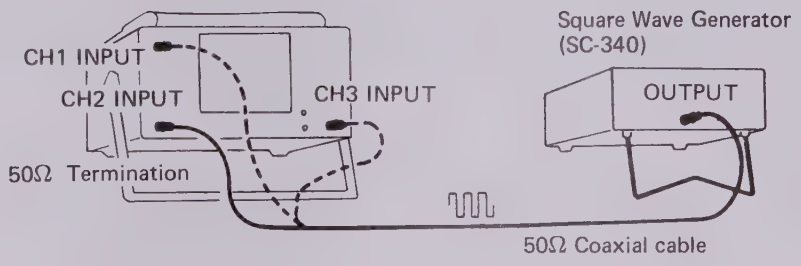
Figure 4-8-3

VOLTS/DIV RANGE	CH1 side capacitor	CH2 side capacitor
5 mV	(6): C0302	
10 mV	(7): C0211, C0212	(1): C0241, C0242
20 mV	(8): C0214, C0215	(2): C0244, C0245
50 mV	(9): C0216, C0217	(3): C0246, C0247
0.5V	(10): C0220, C0221	(4): C0250, C0251
5V	(11): C0225, C0226	(5): C0255, C0256

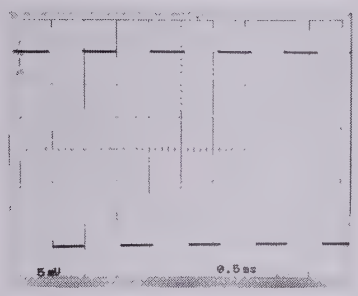
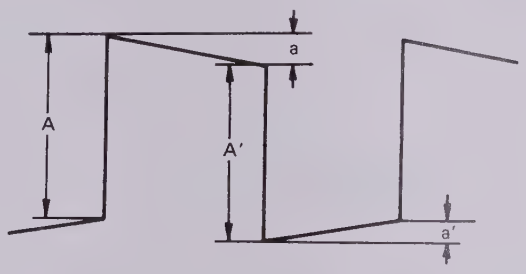
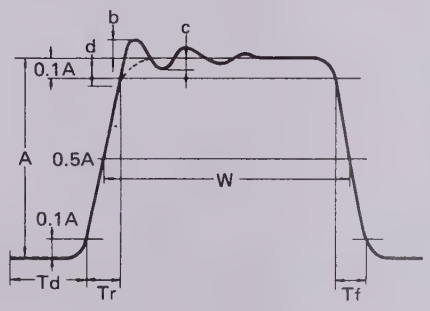
4-8-3 Attenuator Compensation (Cont.)

Item	Description
CRT waveform	Probe Compensation  (a) Proper (b) Improper (overcompensation) (c) Improper (undercompensation)
	Attenuator Compensation  (a) Proper (b) Improper (overcompensation) (c) Improper (undercompensation)

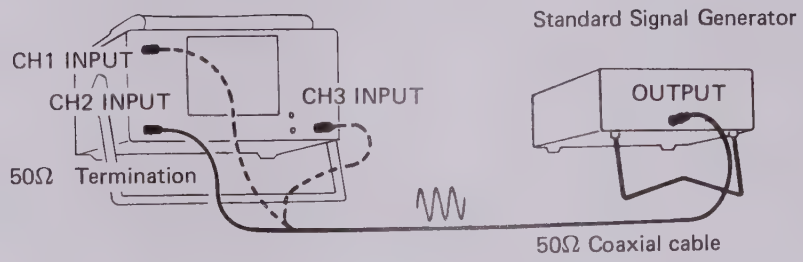
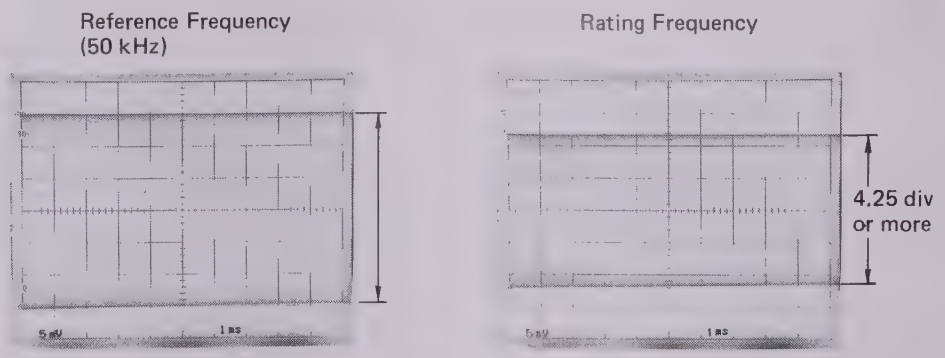
4-8-4 Square Wave Characteristics

Item	Description
Rating	CH1 · CH2 Overshoot : 7% (at 5 mV/div) Sag (at 1 kHz) : 2% (at 5 mV/div) Other distortion : 5% (at 5 mV/div) CH3 Overshoot : 10% (at 0.1V/div) Sag (at 1 kHz) : 3% (at 0.1V/div) Other distortion : 9% (at 0.1V/div)
Connection	
Setting	VOLTS/DIV (CH1 · CH2) : 5 mV/div V COUPL : DC Square Wave Generator output : 60 Hz to 1 MHz
Check and adjustment	——— **CH1 · CH2** ——— 1. Adjust the waveform with C0313, C0413, R0560, C0521, R0766 and C0707. ——— **CH3** ——— 2. Adjust the waveform with R0535, C0516 and C0832.
Adjuster locations	C0832 HORIZ Figure 4-7-1. C0313 PRE and C0413 PRE Figure 4-7-2. C0521 PRE and R0560 PRE Figure 4-7-3. C0516 PRE, R0535 PRE, C0707 V MAIN and R0766 V MIN Figure 4-7-4.

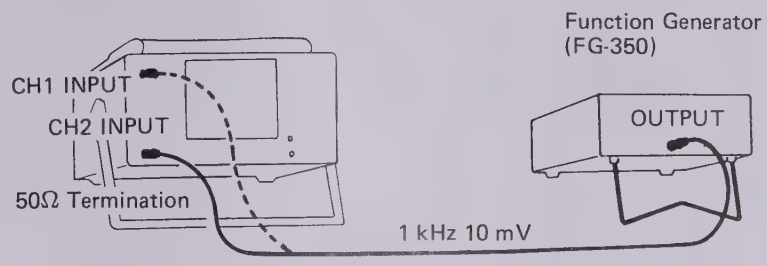
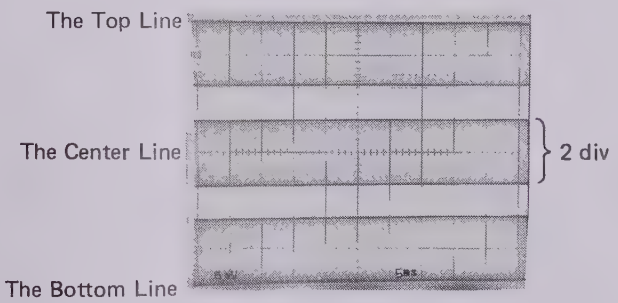
4-8-4 Square Wave Characteristics (Cont.)

Item	Description
CRT waveform	 Input Signal: Square Wave 1 kHz 60 mV
Reference	 Sag = $\frac{a}{A}$ (or $\frac{a'}{A'}$) x 100% The larger of $\frac{a}{A}$ or $\frac{a'}{A'}$ is taken. (Electronic Machinery Industry Association MEA-27)
	 A : Standard Amplitude; $\frac{b}{A}$: Overshoot; $\frac{c}{A}$: Ringing; W : Pulse Width; Tr : Rise Time; Tf : Fall Time; $\frac{d}{A}$: Roundness; Td : Signal Delay Time

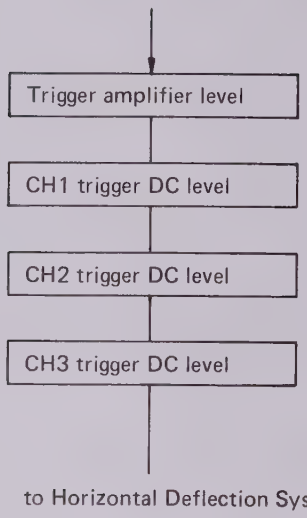
4-8-5 Bandwidth

Item	Description				
Rating	CH1 • CH2	5 mV to 0.2V/div	DC to 60 MHz	–3dB	(DS-6612)
			DC to 40 MHz	–3dB	(DS-6411)
		1 mV/div, 2 mV/div	DC to 20 MHz	–3dB	(DS-6612, DS-6411)
	CH3	0.1V/div	DC to 60 MHz	–3dB	(DS-6612)
			DC to 40 MHz	–3dB	(DS-6411)
Connection					
Setting	CH1 • CH2 VOLTS/DIV : 5 mV/div and 1 mV/div CH3 VOLTS/DIV : 0.1V/div				
Check	1. Set the reference frequency to 50 kHz and adjust the signal generator so that the amplitude swings 6 divisions. 2. Then, change the frequency corresponding to each rating, and read the amplitude to check whether it is within the rating.				
CRT waveform					

4-8-6 Linearity

Item	Description
Rating	±5% (at 1 kHz)
Connection	
Setting	CH1 • CH2 VOLTS/DIV : 5 mV/div
Check	1. Set the amplitude to 2 div at the center of the screen. 2. Check that the amplitude change is within 5%, by shifting the waveform to the top line and to the bottom line with ↕ POSITION.
CRT waveform	Input Signal : Sine Wave 1 kHz 

4-9 TRIGGERING



R1310 LEVEL ADJ (4-9-1)

R03114 CH1 TRIG DC (4-9-1)

R0489 CH2 TRIG DC (4-9-1)

R0840 CH3 LEVEL (4-9-1)

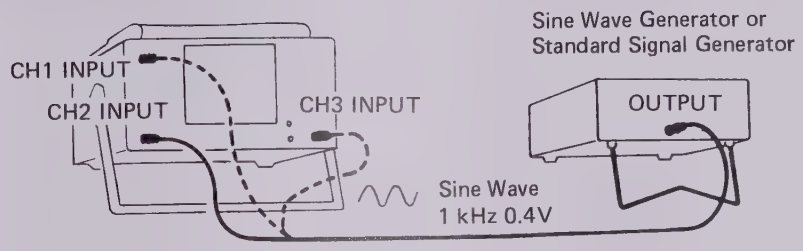
4-9 TRIGGERING

4-9-1 A Trigger

Item: Rating

Triggering Frequency Range	The minimum triggering level (division)	
	CH1 • CH2	CH3
DC to 5 MHz	0.5	1.0
5 MHz to 60 MHz (DS-6612) 5 MHz to 40 MHz (DS-6411)	1.5	3.0

Item: Connection



Item: Setting Check and adjustment

—— **CH1 TRIG LEVEL ADJUST** ——

1. Setting
   VERT MODE : CH1
   CH1 VOLTS/DIV : 0.1V/div
   A SLOPE : +
   A SOURCE : CH1
   TRIGGER LEVEL : CENTER
   A COUPLING : AC
2. Adjust with R1310 LEVEL ADJ to trigger at the center of amplitude.

—— **CH1 TRIG DC LEVEL** ——

3. Setting
   A COUPLING : DC
4. Adjust with R03114 CH1 TRIG DC to trigger at the center of amplitude.

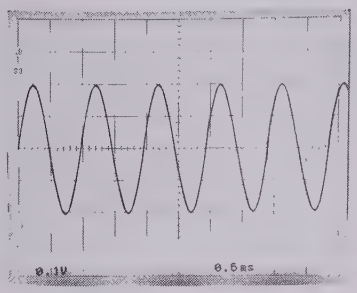
—— **CH2 TRIG LEVEL ADJUST** ——

5. Setting
   CH2 VOLTS/DIV : 0.1V/div
   A SOURCE : CH2
6. Adjust with R0489 CH2 TRIG DC to trigger at the center of amplitude.

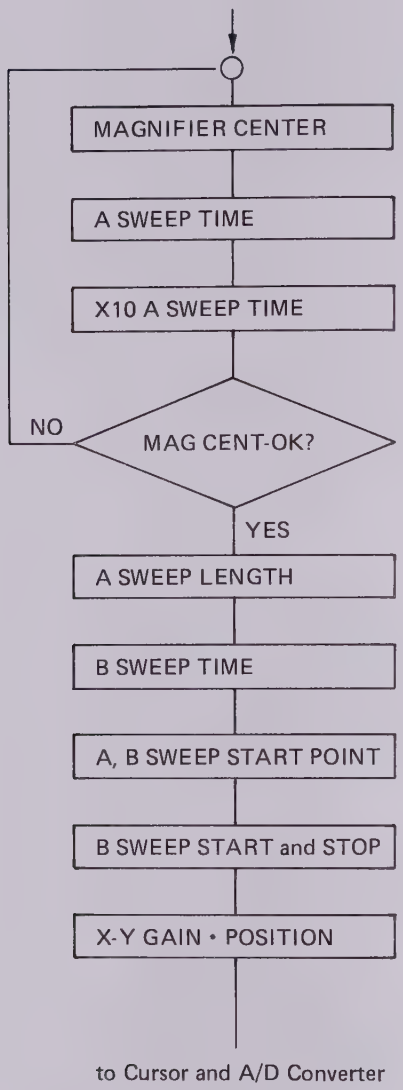
—— **CH3 TRIG LEVEL ADJUST** ——

7. Setting
   VERT MODE : TR1 + CHOP
   CH3 VOLTS/DIV : 0.1V/div
   A SOURCE : CH3
8. Adjust with R0840 CH3 LEVEL to trigger at the center of amplitude.

4-9-1 A Trigger (Cont.)

Item	Description
CRT waveform	Input Signal : Sine Wave 1 kHz 0.4V **Level Adjustment** 
Adjuster locations	R0489 CH2 TRIG DC, R0840 CH3 LEVEL and R03114 CH1 TRIG DC Figure 4-7-1. R1310 LEVEL ADJ Figure 4-7-3.

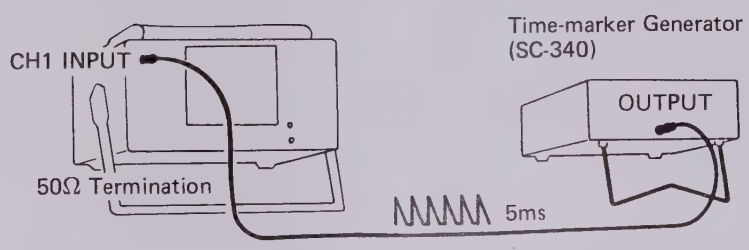
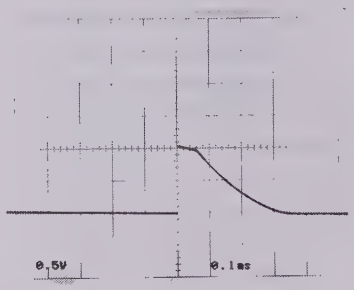
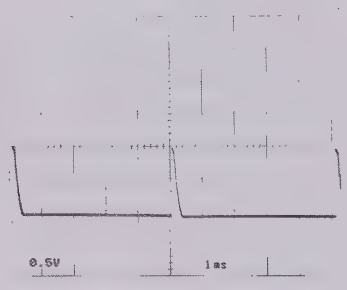
4-10 HORIZONTAL DEFLECTION SYSTEMS



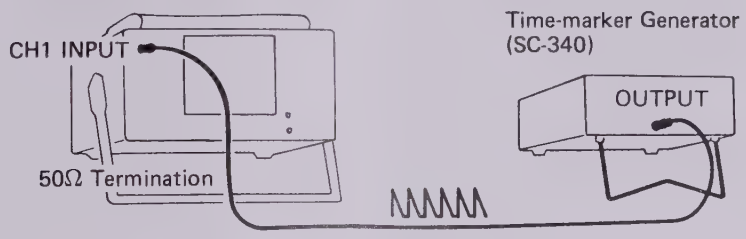
R1453	MAG CNET	(4-10-1)
R1423	NORM GAIN	(4-10-2)
C0913		
R1419	MAG GAIN	(4-10-3)
C1419		
C1424		
R0926	A LENGTH	(4-10-4)
R1223	B TIMING	(4-10-2)
C1109		
R1122	B START ADJ	(4-10-5)
R1326	DL STAT	(4-10-6)
R1323	DL STP	
R1355	X-Y GAIN	(4-10-7)
R1357	X-Y LEVEL	

4-10 HORIZONTAL DEFLECTION SYSTEMS

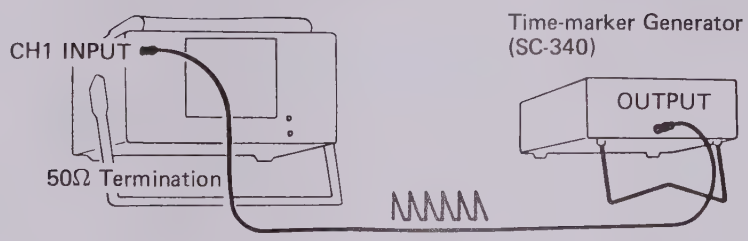
4-10-1 Magnifier Center

Item	Description
Connection	
Setting	A SEC/DIV : 1 ms/div PULLX10 MAG : ON
Check and adjust	1. Adjust 2nd pulse peak to the center of the CRT screen with ↔ POSITION. 2. Switch off X10 MAG and adjust with R1453 MAG CENT so that the shift of 2nd pulse peak is minimized.
CRT waveform	X10 MAG ON Setting  X10 MAG OFF Adjustment 
Adjuster locations	R1453 MAG CENT Figure 4-7-3.

4-10-2 A Sweep Time Accuracy

Item	Description
Rating	Accuracy I (over center 8 divisions) 50 ns to 0.5 s ±2% Accuracy II (over any 2 of the center 8 divisions) 0.2 μs to 0.5 s ±5% Accuracy III (over any 2 of the center 8 divisions) 50 ns to 0.1 μs ±7%
Connection	
Setting Check and adjust	**——A SEC/DIV——** a. NORM GAIN 1. Set ASEC/DIV to 1 ms/div. 2. Verify the VARIABLE is calibration. 3. Adjust sweep time accuracy with R1423 NORM GAIN. 4. Verify the sweep time accuracy of 0.5 s/div to 0.1 ms/div. b. 5 μs/div 5. Set A SEC/DIV to 5 μs/div. 6. Adjust sweep time accuracy with C0913. 7. Verify the sweep time accuracy of 50 μs/div to 50 ns/div. **——B SEC/DIV——** a. Timing ADJ 8. Set A SEC/DIV slower than B SEC/DIV. 9. Set the delay time near the start point. 10. Set B SEC/DIV to 1 ms/div 11. Adjust sweep time accuracy with R1223. 12. Verify the sweep time accuracy of 50 ms/div to 0.1 ms/div. b. 5 μs/div 13. Set B SEC/DIV to 5 μ/div 14. Adjust sweep time accuracy with C1109. 15. Verify the sweep time accuracy of 50 μs/div to 50 ns/div
Adjuster locations	R1423 NORM GAIN and R1223 TIMING Figure 4-7-1. C0913 A ADJ and C1109 B SWEEP ADJ Figure 4-7-3.

4-10-3 X10 A Sweep Time

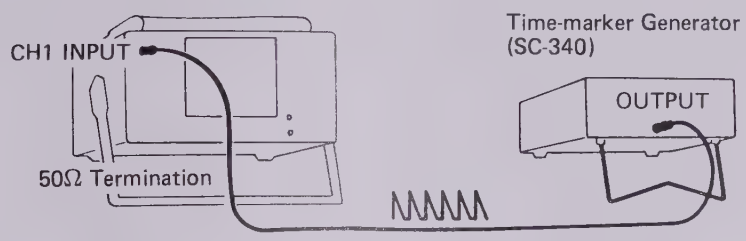
<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Rating</td><td>
<table>
<tr><td>Accuracy I (over center 8 divisions)</td><td>50 ms to 20 ns
10 ns to 5 ns</td><td>±4%
±5%</td></tr>
<tr><td>Accuracy II (over any 2 of the center 8 divisions)</td><td>50 ms to 20 ns
10 ns to 5 ns</td><td>±6%
±10%</td></tr>
</table>
(Excluding start 20 ns and stop 40 ns)
</td></tr>
<tr><td>Connection</td><td>


</td></tr>
<tr><td>Setting
Check and
adjust</td><td>
—— A SEC/DIV ——
a. 0.1 ms/div
1. Set A SEC/DIV to 1 ms/div.
2. Set X10 MAG
3. Adjust accuracy with R1419 MAG GAIN.
4. Verify the accuracy of 50 ms/div to 20 ns/div (at X10)
b. 5 ns/div
5. Set A SEC/DIV to 50 ns/div
6. Set X10 MAG
7. Adjust accuracy with C1419, C1424
8. Verify the accuracy of 10 ns/div (at X10)

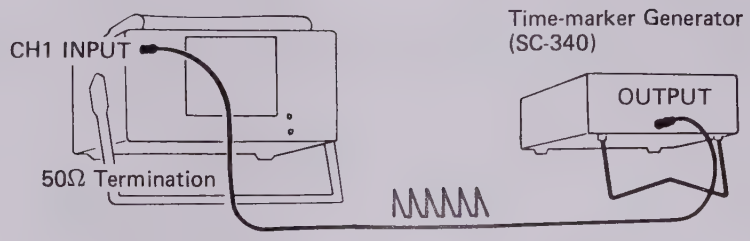
—— B SEC/DIV ——
Same as A SEC/DIV

CAUTION
Verify DS-6411 until 10 ns/div
</td></tr>
<tr><td>Adjuster locations</td><td>R1419 MAG GAIN Figure 4-7-1.
C1419 and C1424 Figure 4-7-3.</td></tr>
</table>

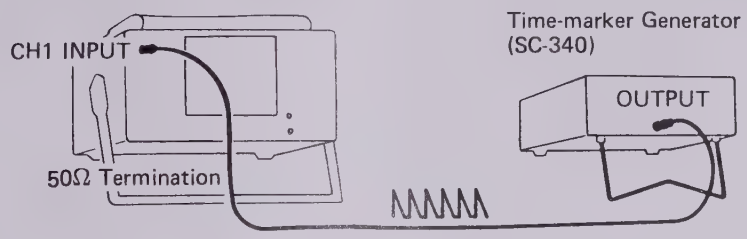
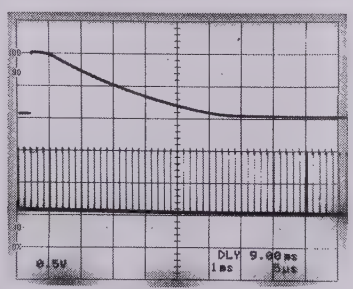
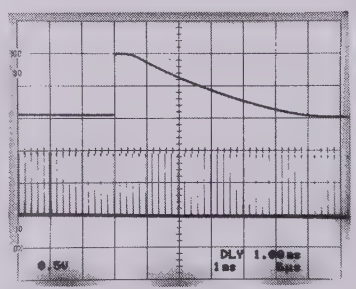
4-10-4 A Sweep Length

Item	Description
Connection	
Setting	A SEC/DIV : 1 ms/div Time marker generator : 1 kHz
Check and adjust	1. Adjust with R0926 A LENGTH so that pulse line is 11 divisions (Verify the pulse line at the outside of the CRT screen by turning ↔ POSITION.) 2. Verify pulse line become from 10.5 divisions to 13.5 divisions at all ranges.
Adjuster locations	R0926 A LENGTH Figure 4-7-3.

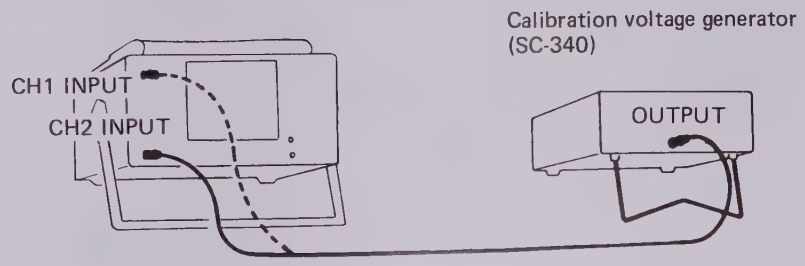
4-10-5 A, B Sweep Start Point

Item	Description
Connection	
Setting	A SEC/DIV : 1 ms/div PULL X10 MAG : ON B HORIZ DISPLAY : TRIG' D HORIZ DISPLAY : ALT DELAY TIME : 200, 0 μ SEC
Check and adjust	Adjust Start point A sweep and B sweep with R1122 B START ADJ.
Adjuster locations	R1122 B START ADJ Figure 4-7-3.

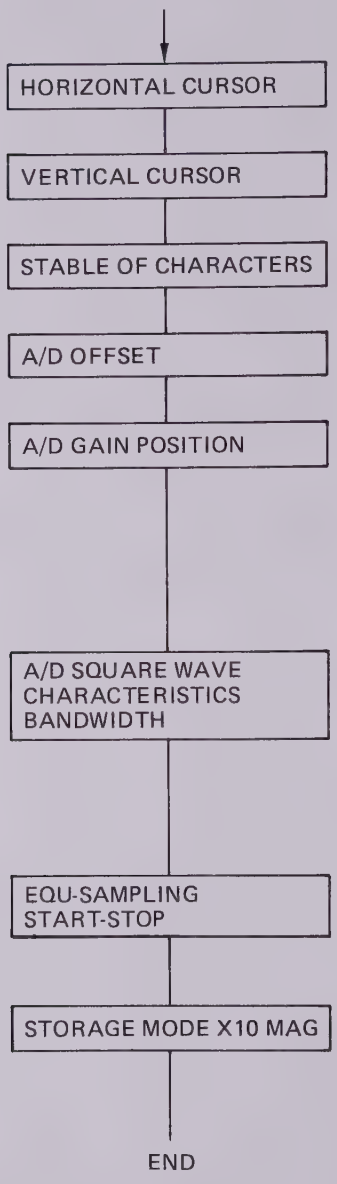
4-10-6 B Sweep Start and Stop

Item	Description
Rating	Accuracy I (over center 8 divisions): All ranges ±2% Accuracy II (over any 2 of the center 8 divisions): 0.2 μs/div to 50 ms/div ±5%; 0.1 μs/div ±7%
Connection	
Setting	HORIZ DISPLAY : ALT A SEC/DIV : 1 ms/div B SEC/DIV : 5 μs/div B SOURCE : RUN AFT Time marker generator : 0.2 ms
Check and adjust	1. Adjust with R1323 DL STOP so that B sweep edge of 46th correspond to A sweep pulse edge when DLY value is 90.0 ms. 2. Adjust with R1326 DL STAT so that B sweep edge of 6th correspond to A sweep pulse edge when DLY value is 1.00 ms. **CAUTION** *Adjustments should be done repeatedly, since DELAY START and DELAY STOP affect each other.*
CRT waveform	DELAY TIME MULT Start location  DELAY TIME MULT Stop location 
Adjuster locations	R1323 DL STOP and R1326 DL STAT Figure 4-7-3.

4-10-7 X-Y Gain · Position

Item	Description
Rating	Gain (Same as Vertical Deflection System) accuracy ±5%
Connection	
Setting	CH1 VOLTS/DIV : 5 mV/div A SEC/DIV : 1 ms/div
Check and adjust	1. Set CH1 AC-GND-DC to GND. 2. Adjust H POSITION so that the sweep edge and the left edge of the CRT scale line meet each other. 3. Set HORIZ DISPLAY to X-Y. 4. Adjust R1357 X-Y LEVEL so that spot location can be the center of the CRT screen (to horizontal scale line). 5. Set CH1 AC-GND-DC to AC. 6. Adjust with R1355 X-Y GAIN so that the amplitude can be ±3 divisions from the center of the CRT screen. (If the amplitude is outside the rated value, adjustments should be done repeatedly, since 4 and 6 affect each other.) 7. Check the all range of CH1 VOLTS/DIV.
Adjuster locations	R1355 X-Y GAIN and R1357 X-Y LEVEL Figure 4-7-1.

4-11 CURSOR · A/D CONVERTER SYSTEM



R0701	ST. C. GAIN	(4-11-1)
R0716	ST. C. POS.	
R1475		(4-11-2)
R1466		
R0774		(4-11-3)
R35160	CH1 A/D OFFSET	(4-11-4)
R35260	CH2 A/D OFFSET	
R0607	CH1 A/D GAIN	(4-11-4)
R0616	CH1 A/D POS	
R0647	CH2 A/D GAIN	
R0656	CH2 A/D POS	
R0634	R0674	(4-11-5)
C0601	C0641	(4-11-6)
R35128	R35228	
R35113	R35213	
C35131	C35231	
R35315	EQU STOP	(4-11-7)
R35319	EQU START	
R1490		(4-11-8)

4-11-1 Horizontal Cursor

Item	Description
Rating	at ±3 divisions on the center of the CRT screen ±0.8% of reading ±0.35% of F.S F.S is value of VOLTS/DIV X10
Setting	CH1 VOLTS/DIV : 10 mV/div Set CH1, CH2 AC-GND-DC to GND After power on, Set the cursors C1 to 55 mV Set the cursors C2 to 60 mV
Check and adjust	1. Adjust with R0701 ST C GAIN and R0716 ST C POS so that cursors come ±3 divisions on the center of the CRT screen.
Adjuster locations	R0701 STC GAIN and R0716 STC POS Figure 4-7-4.

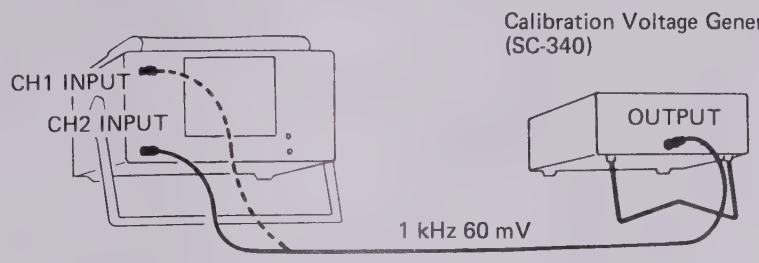
4-11-2 VERTICAL CURSOR

Item	Description
Rating	at ±4 divisions on the center of the CRT screen ±0.9% of reading ±0.45% of F.S F.S is value of SEC/DIV X10
Setting	A SEC/DIV : 1 ms/div Set CH1, CH2 AC-GND-DC to GND after power on Set the cursor C1 to 6.5 ms Set the cursor C2 to 8.0 ms
Check and adjust	1. Adjust with R1475 CHARA GAIN and R1466 CHARA POS so that cursors come ±4 divisions on the center of the CRT screen.
Adjuster locations	R1466 CHARA POS and R1475 CHARA GAIN Figure 4-7-1.

4-11-3 Stable of Characteristics

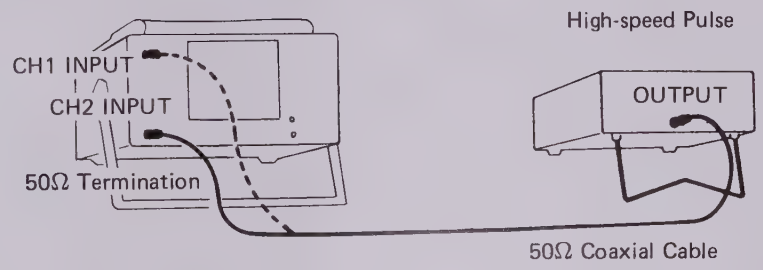
Item	Description
Setting Check and adjust	a. Horizontal 1. Set AEC/DIV to 10 ms/div. 2. Set X10 MAG. 3. Verify the horizontal unstability of a character. b. Vertical 4. Set VERT MODE to ALT 5. Set CH1 trace to +4 divisions. 6. Set CH2 trace to −4 divisions. 7. Adjust with R0774 so that the vertical unstability of a character is minimized.
Adjuster locations	R0774 Figure 4-7-4.

4-11-4 A/D Converter OFFSET ◦ GAIN Position

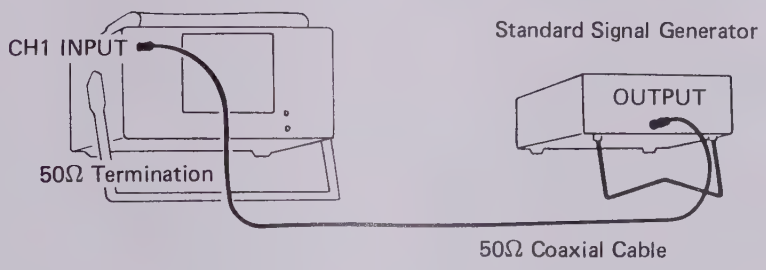
Item	Description
Connection	
Setting Check and adjust	a. OFFSET 1. Set A SEC/DIV to 10 μs/div. 2. Set VOLTS/DIV to 5 mV/div. 3. Move the trace to the center of the CRT screen under REAL TIME MODE. 4. Set the STORAGE MODE 5. Adjust with R0616 CH1 A/D POS and R0656 CH2 A/D POS so that the trace cames to the center of the CRT screen. 6. Adjust with R35160 CH1 A/D OFFSET and R35260 CH2 A/D OFFSET so that the CH1 trace and CH2 trace cames to the center of the CRT screen. b. GAIN POSITION 7. Set REAL TIME MODE. 8. Input 50 kHz sine wave and set the CRT amplitude to ±3 divisions. 9. Set STORAGE MODE. 10. Adjust GAIN and POSITION with R0607 CH1 A/D GAIN R0616 CH1 A/D POS, R0647 CH2 A/D GAIN, R0656 CH2 A/D POS so that it becomes equal to REAL MODE. 11. Adjust with C35132 and C35232 so that the difference in GAIN between 10 MHz clock and Equ-sampling is extinguished. 12. When a gain difference from the REALTIME mode takes place in Step 11, take Step 10 again for readjustment. **CAUTION** *The DS-6411 require only the adjustment in Step 10.* *When making the adjustments in "b", attach a side plate and conduct a heat run beforehand.*
Adjuster locations	R0616 CH1 A/D POS, R0656 CH2 A/D POS, R0607 CH1 GAIN, R0616 CH1 A/D POS, R0647 CH2 A/D GAIN and R0656 CH2 A/D POS Figure 4-7-4. R35160 CH1 A/D OFFSET, R35260 CH2 A/D OFF SET, C35132 and C35232 Figure 4-7-5.

4-11-5 Square Wave Characteristics in STORAGE Mode (Overshoot and Other Distortions)

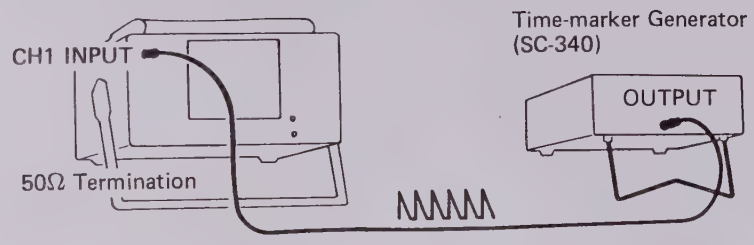
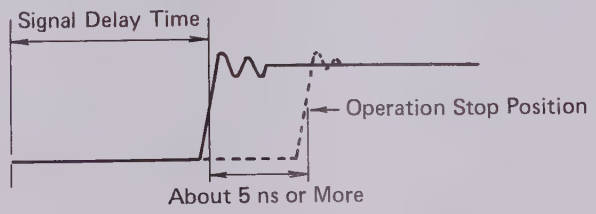
The DS-6411 does not require this adjustment.

Item	Description
Connection	
Setting	VOLTS/DIV : 5 mV/div Equivalent sampling : ON
Check and adjust	1. Adjust with the following regulators so that an input square wave will be flat. CH1: R0634, C0601, R35128, C35131, R35113 CH2: R0674, C0641, R35288, C35231, R35213 Note) Check for 50 ns/div to 50 μs/div.
Adjuster locations	R0634, R0674, C0601 and C0641 Figure 4-7-4. R35128, R35288, C35131, C35231, R35113 and R35213 Figure 4-7-5.

4-11-6 Frequency Band Width

Item	Description
Rating	Frequency which makes an amplitude −3dB Range / Frequency 1.2 mV — 20 5 mV — 60 10 mV to 0.2V — 60
Connection	
Setting and Check	1. Set the Equivalent Sampling mode. 2. Input a sine wave of 50 kHz, 6 div from the standard signal generator. 3. Check that the rating is met by a frequency which makes an amplitude −3dB. Note) Check for 50 ns/div to 50 μs/div.

4-11-7 Equivalent Sampling Start and Stop

Item	Description
Connection	
Setting Check and adjust	1. Set A SEC/DIV to 5 μs/div. 2. Set the Equivalent Sampling mode. 3. Input a 5 μs pulse train. 4. Adjust R35315 EQU STOP so that 1 pulse will result per 1 div. 5. Set A SEC/DIV to 50 ns/div. 6. Set to PULL X10 MAG. 7. Input a pulse with a rise time of 1 ns or less. 8. Adjust R35319 EQU START so that there will be a margin of about 5 ns or more before equivalent sampling stops.  9. Check operation and accuracy between each equivalent sampling sweep range. * The DS-6411 does not require this adjustment.
Adjuster locations	R35315 EQU STOP and R35319 EQU START Figure 4-7-5.

4-11-8 Storage X10

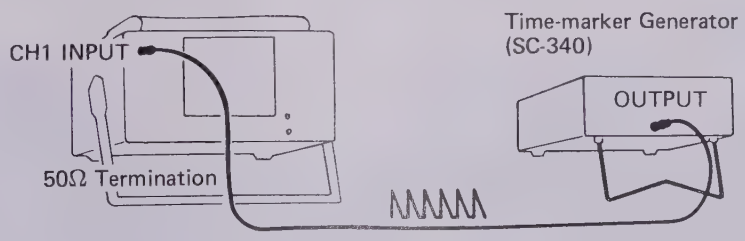
Item	Description
Connection	
Setting Check and adjust	1. Set to 1 ms/div. 2. Input a 0.5 ms pulse train. 3. Set to PULL X10 MAG. 4. Adjust R1490 STORAGE MAG GAIN so that accuracy will be met on the CRT screen.
Adjuster locations	R1490 STORAGE MAG GAIN Figure 4-7-1.

Figure 4-7-1.

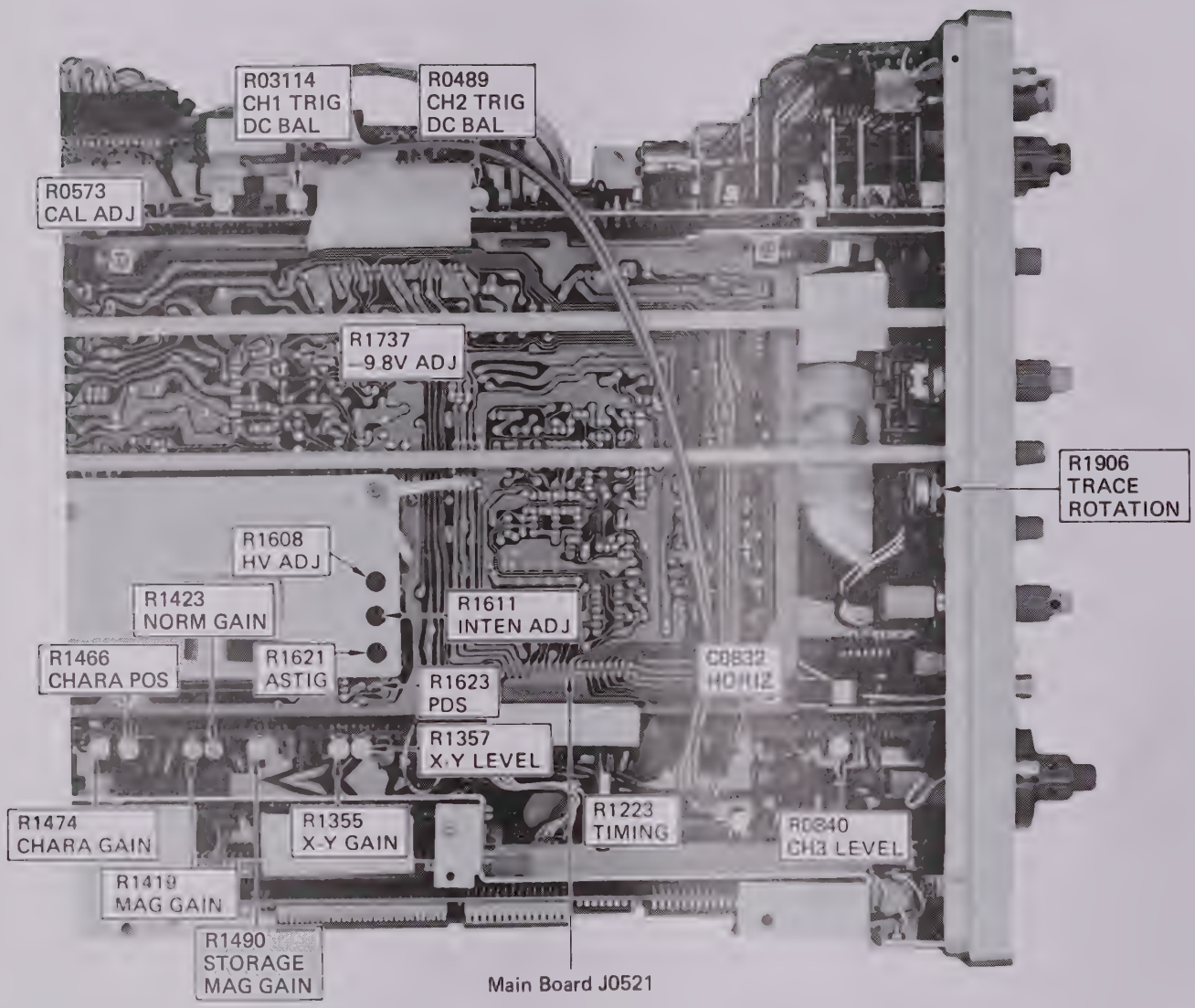

R03114
CH1 TRIG
DC BAL
R0489
CH2 TRIG
DC BAL
R0573
CAL ADJ
R1737
-9.8V ADJ
R1906
TRACE
ROTATION
R1608
HV ADJ
R1423
NORM GAIN
R1611
INTEN ADJ
R1466
CHARA POS
R1621
ASTIG
R1623
PDS
C0832
HORIZ
R1357
X-Y LEVEL
R1474
CHARA GAIN
R1355
X-Y GAIN
R1223
TIMING
R0840
CH3 LEVEL
R1419
MAG GAIN
R1490
STORAGE
MAG GAIN
Main Board J0521

Figure 4-7-2.

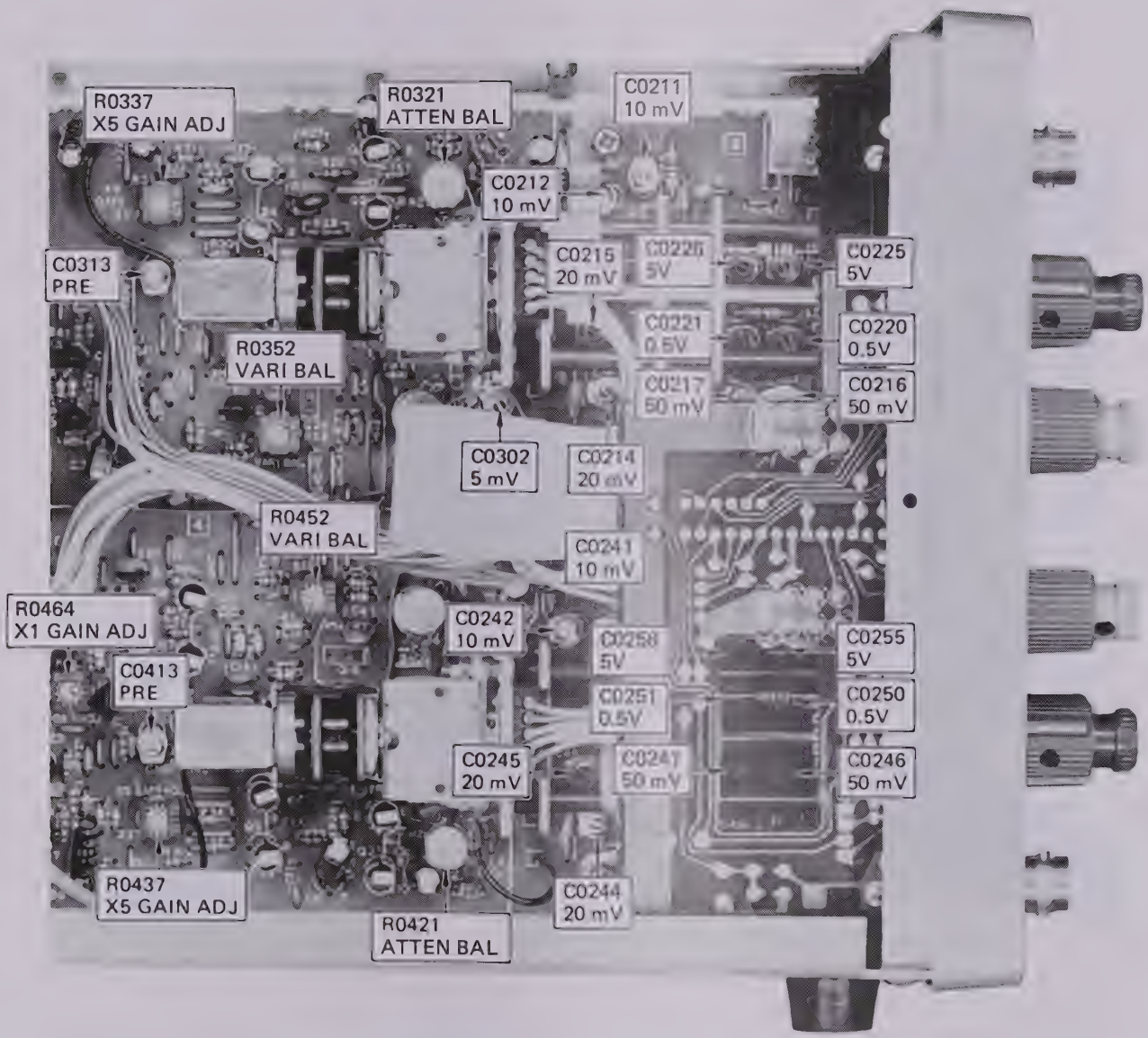

R0337
X5 GAIN ADJ
R0321
ATTEN BAL
C0211
10 mV
C0212
10 mV
C0313
PRE
C0215
20 mV
C0226
5V
C0225
5V
C0221
0.5V
C0220
0.5V
R0352
VARI BAL
C0217
50 mV
C0216
50 mV
C0302
5 mV
C0214
20 mV
R0452
VARI BAL
C0241
10 mV
R0464
X1 GAIN ADJ
C0242
10 mV
C0258
5V
C0255
5V
C0413
PRE
C0251
0.5V
C0250
0.5V
C0245
20 mV
C0247
50 mV
C0246
50 mV
R0437
X5 GAIN ADJ
C0244
20 mV
R0421
ATTEN BAL

Figure 4-7-3.

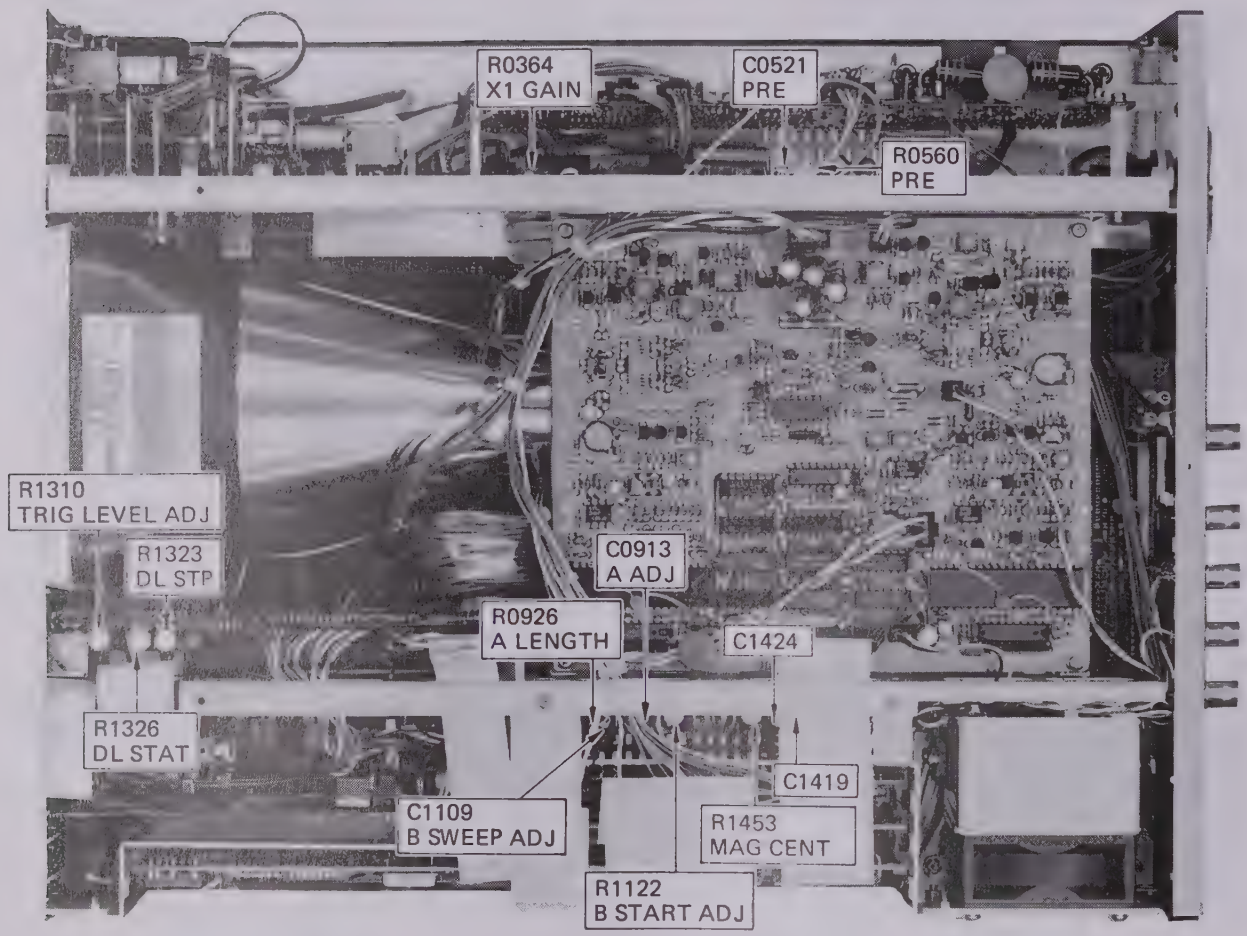

R0364
X1 GAIN
C0521
PRE
R0560
PRE
R1310
TRIG LEVEL ADJ
R1323
DL STP
C0913
A ADJ
R0926
A LENGTH
C1424
R1326
DL STAT
C1419
C1109
B SWEEP ADJ
R1453
MAG CENT
R1122
B START ADJ

Figure 4-7-4. V Main AMP Board [7]

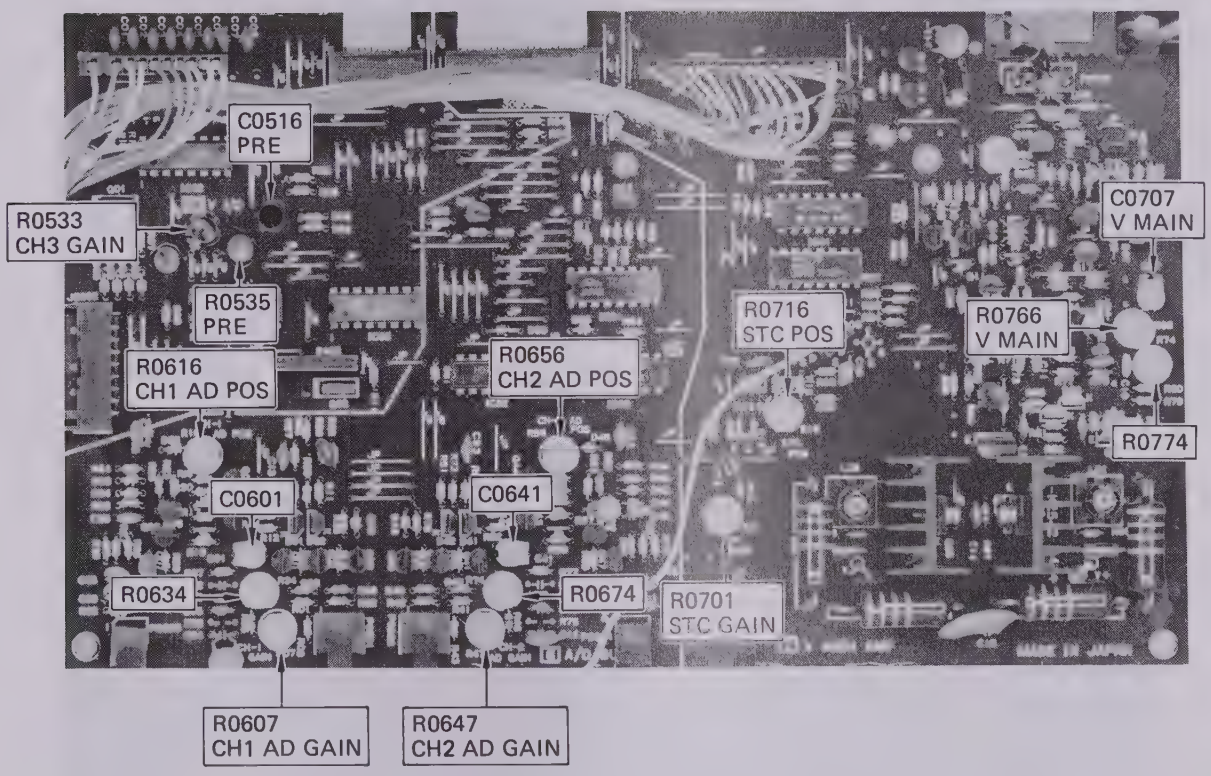
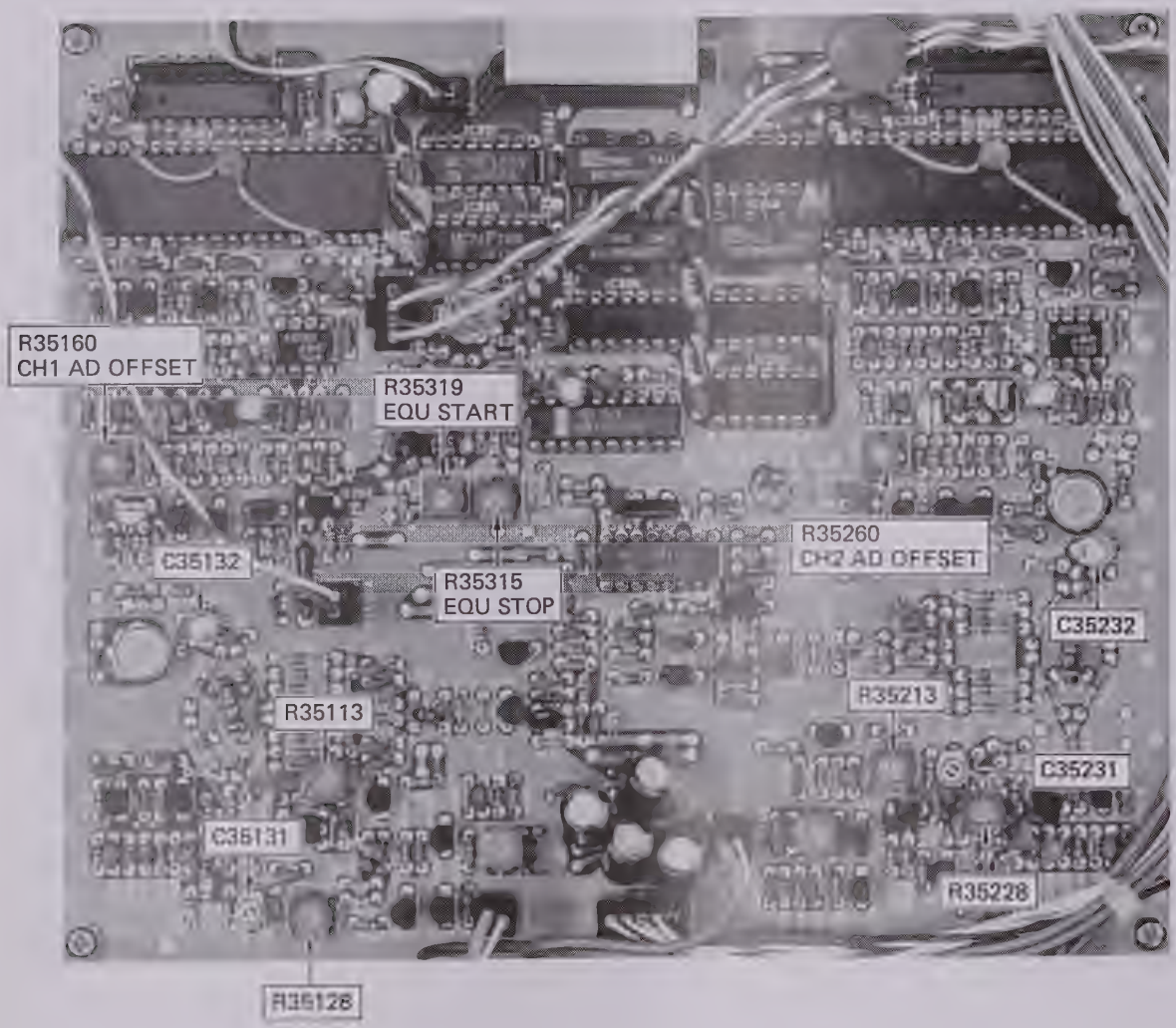
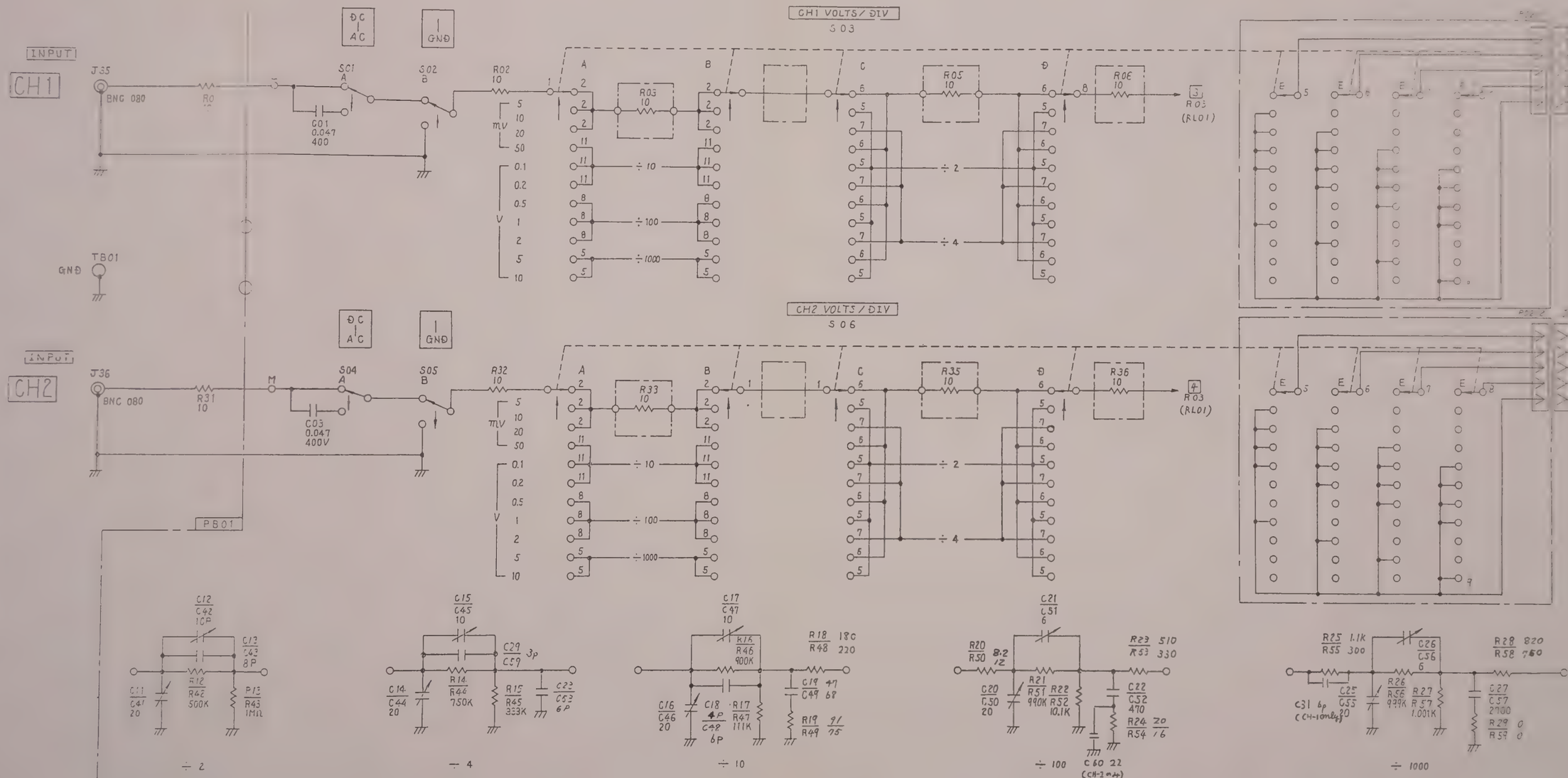


Figure 4-7-5. A/D Board (DS-6612)



Section 5 Schematic Diagrams

1	Missing number	
2	ATT	DS-6612
		DS-6411
3	CH1 PRE	DS-6612
	CH1 PRE	DS-6411
4	CH2 PRE	DS-6612
	CH2 PRE	DS-6411
5	V CONT	DS-6612/6411
6	A/D BUFF	DS-6612
		DS-6411
7	V MAIN	DS-6612/6411
8	TRIG G	DS-6612/6411
9	A SWEEP G	DS-6612/6411
10	A TIMING	DS-6612
		DS-6411
11	B SWEEP G	DS-6612/6411
12	B TIMING	DS-6612
		DS-6411
13	M COUNT	DS-6612/6411
14	H AMP	DS-6612/6411
15	Z AMP	DS-6612/6411
16	HV & CRT	DS-6612/6411
17	POWER	DS-6612
		DS-6411
18	POS	DS-6612/6411
19	VR	DS-6612/6411
20	V I/O	DS-6612/6411
21	H I/O	DS-6612
		DS-6411
22 to 29	Missing number	
30	CHA-A	DS-6612/6411
31	CHA-B	DS-6612/6411
32	CHA-C	DS-6612/6411
33	D/A	DS-6612/6411
34	Missing number	
35	A/D	DS-6612
36	A/D	DS-6411
37 to 40	Missing number	
41	DM COUNT	DS-6612/6411
42 to 49	Missing number	
50	BLOCK I/O	
51	CPU-1	DS-6612
		DS-6411
52	CPU-2	DS-6612/6411
53	CPU-3	DS-6612/6411
54	CPU-4	DS-6612/6411
55	KEY BOARD	DS-6612/6411
56 to 57	Missing number	
58	GP-IB	



	5	6	7	8
5mV 0	0	0	0	0
10mV 1	1	0	0	0
20mV 2	1	1	0	0
50mV 3	1	1	1	0
·1V 4	1	1	1	1
·2V 5	0	1	1	1
·5V 6	0	0	1	1
1V 7	1	0	0	1
2V 8	0	1	0	0
5V 9	0	0	1	0
10V 10	0	0	0	1

[Note]

CH1 and CH2 are a common schematic diagram.

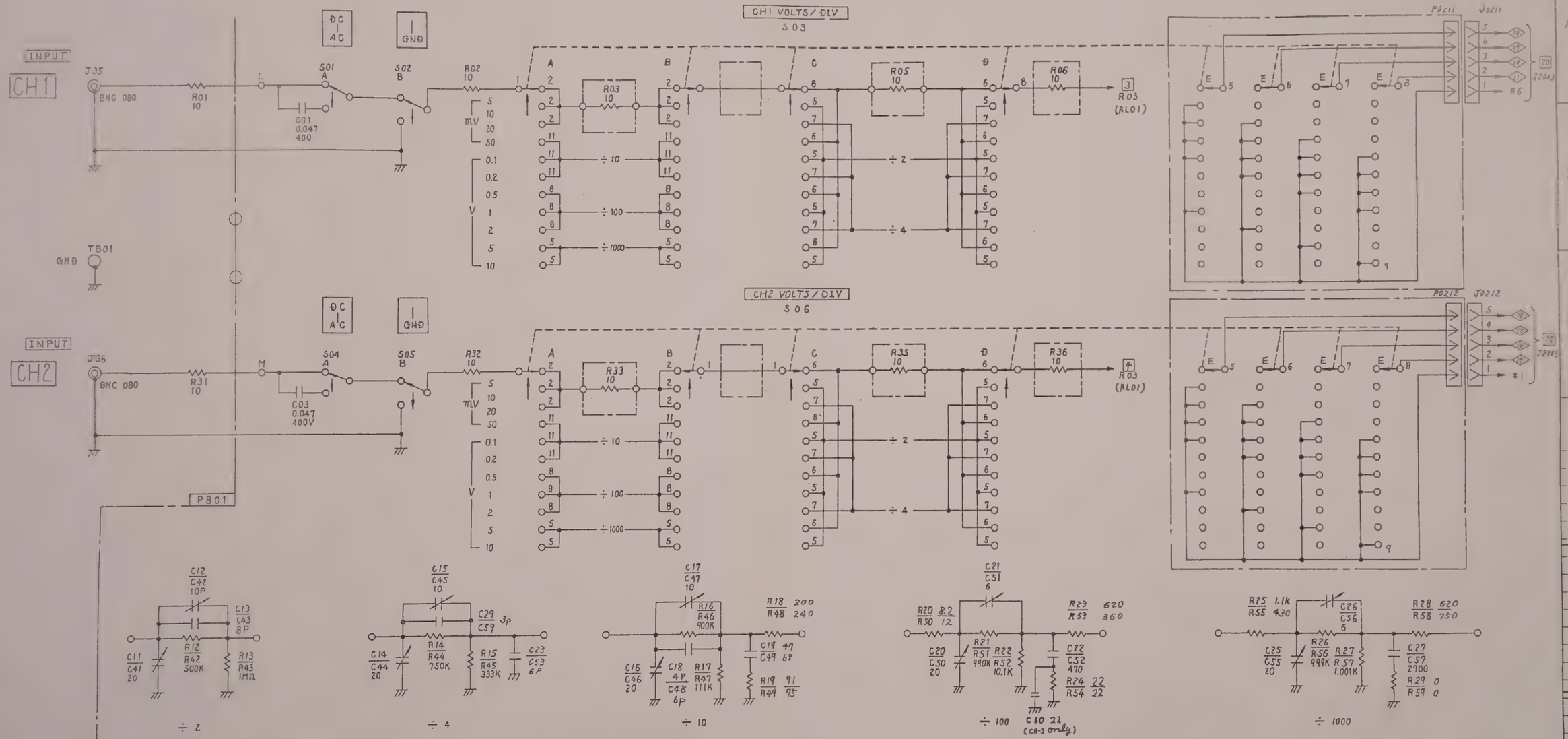
Shows CH1 at upside, CH2 at downside

Exsample

CH1 ⟶ C19 47
CH2 ⟶ C49 68

DS-6612
ATT 2

BBWDS 24002105 | 1



	5	6	7	8
5mV 0	0	0	0	0
10mV 1	1	0	0	0
20mV 2	1	1	0	0
50mV 3	1	1	1	0
·1V 4	1	1	1	1
·2V 5	0	1	1	1
·5V 6	0	0	1	1
1V 7	1	0	0	1
2V 8	0	1	0	0
5V 9	0	0	1	0
10V 10	0	0	0	1

[Note]

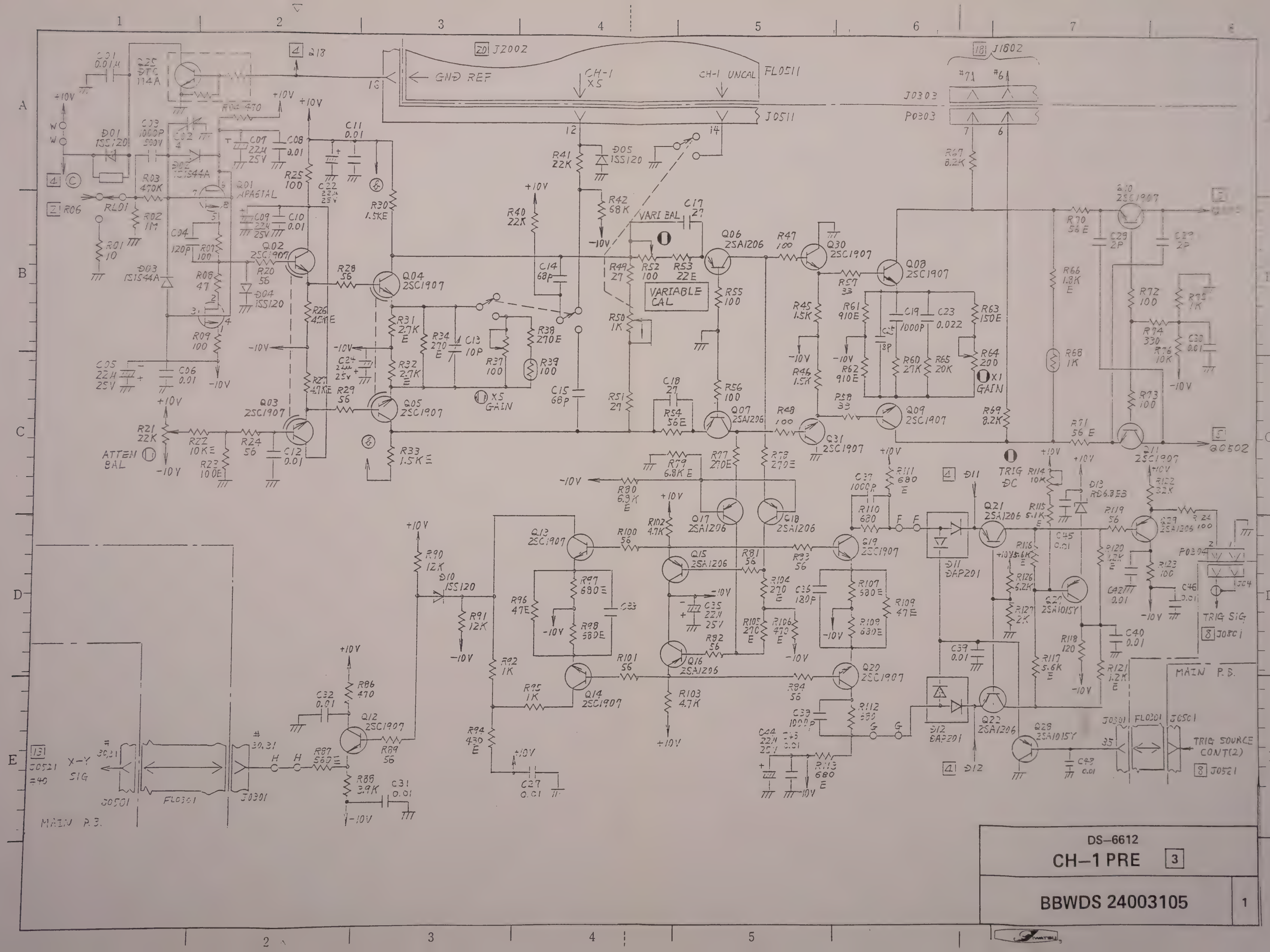
CH1 and CH2 are a common schematic diagram.

Shows CH1 at upside, CH2 at downside.

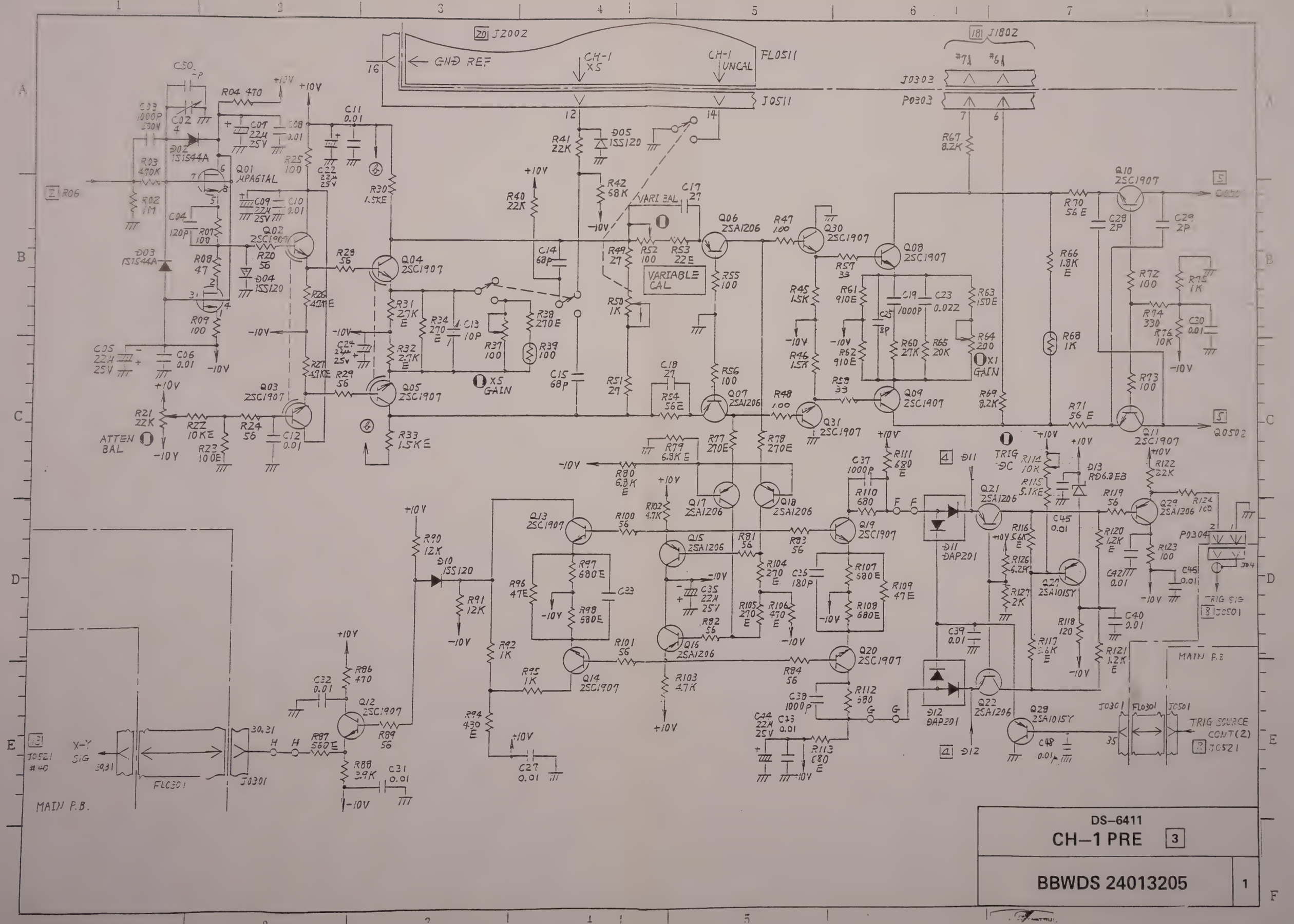
Exsample

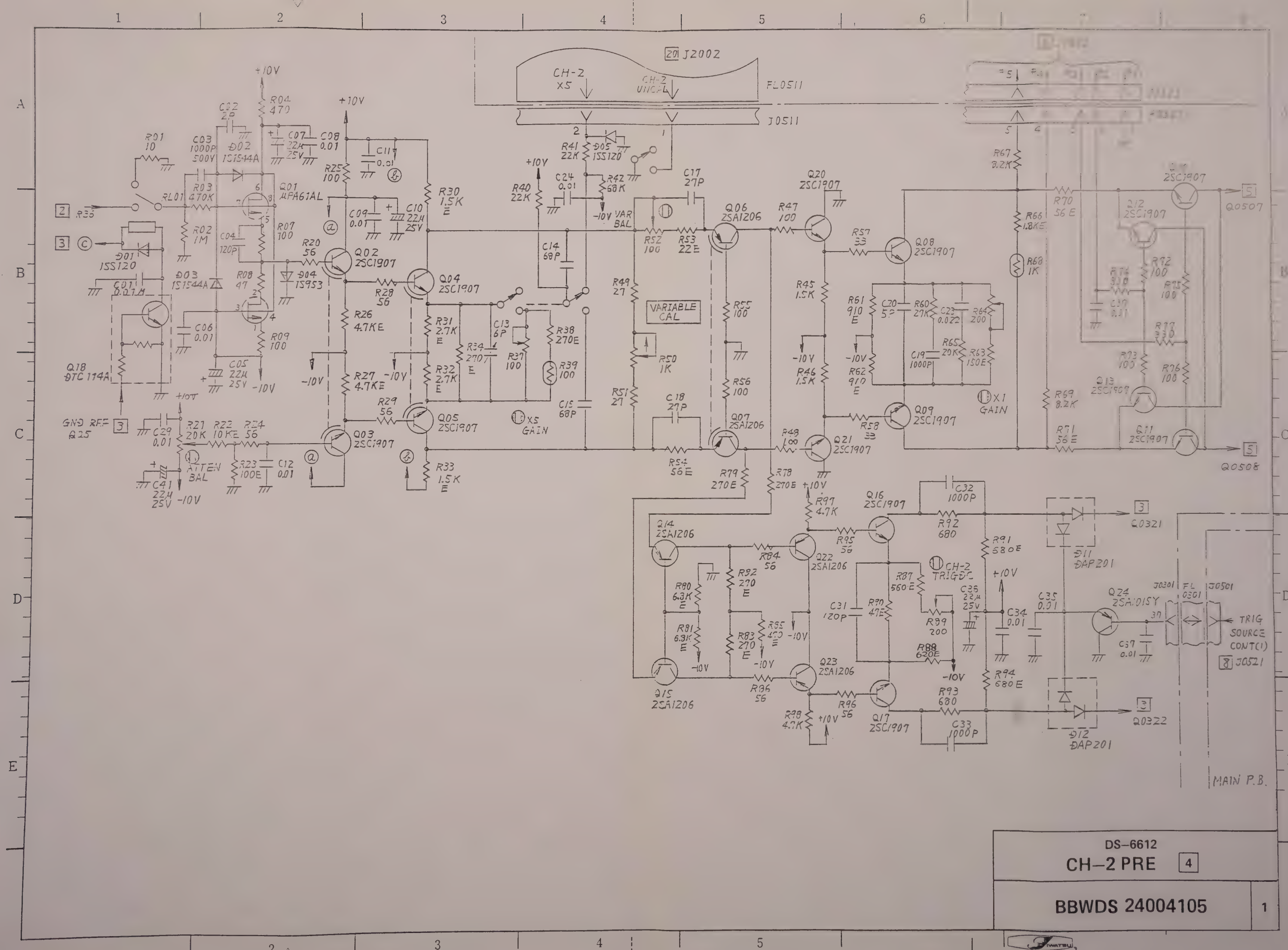
CH1 ⟶ C19 47
CH2 ⟶ C49 68

DS-6411
ATT 2
GBWDS 24023105 1

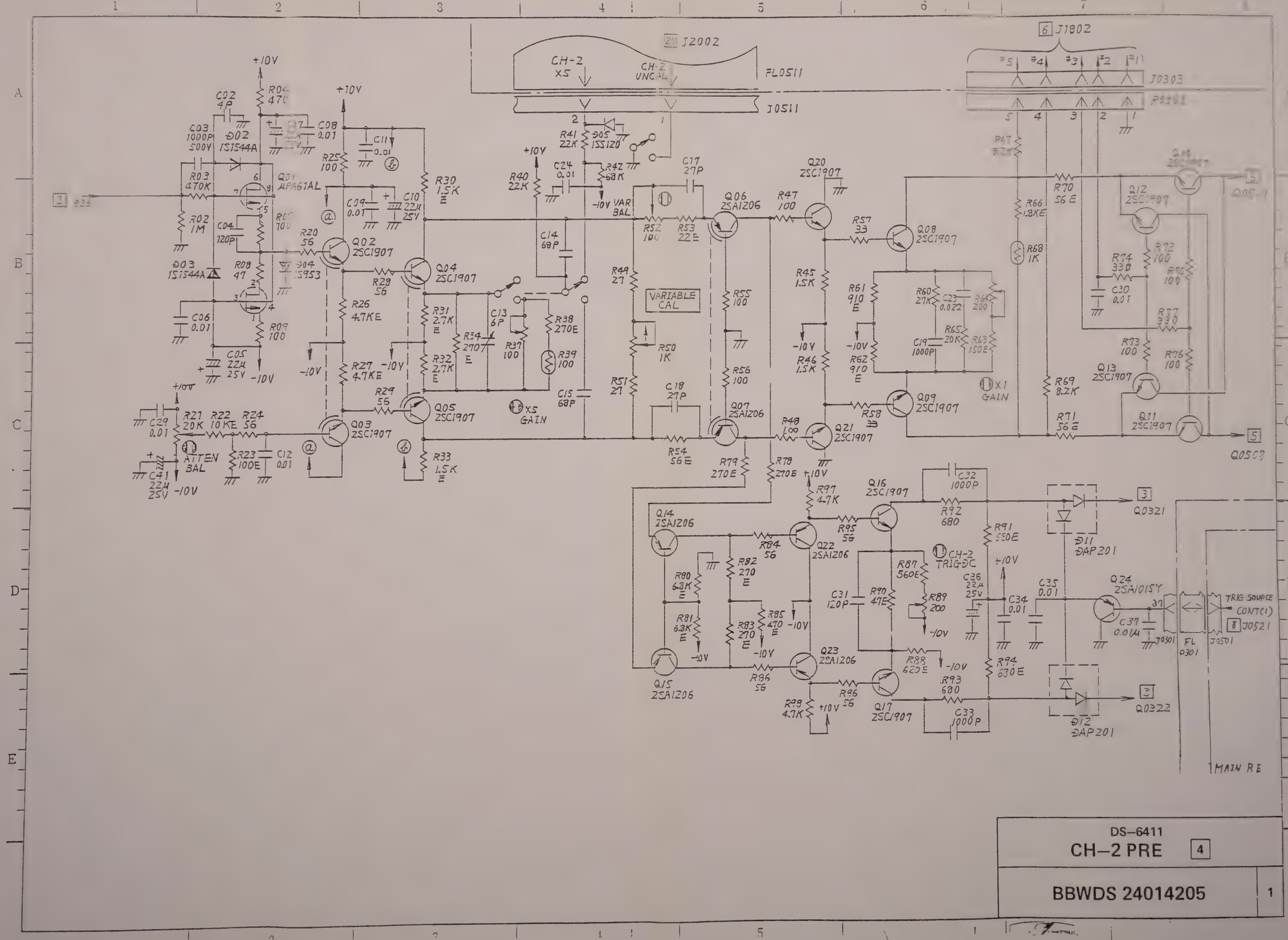


DS–6612	
CH–1 PRE 3	
BBWDS 24003105	1


J2002
GND REF
CH-1 XS
CH-1 UNCAL
FL0511
J0511
J1802
J0303
P0303
Q01 μPA67AL
Q02 2SC1907
Q03 2SC1907
Q04 2SC1907
Q05 2SC1907
Q06 2SA1206
Q07 2SA1206
Q08 2SC1907
Q09 2SC1907
Q10 2SC1907
Q11 2SC1907
Q12 2SC1907
Q13 2SC1907
Q14 2SC1907
Q15 2SA1206
Q16 2SA1206
Q17 2SA1206
Q18 2SA1206
Q19 2SC1907
Q20 2SC1907
Q21 2SA1206
Q22 2SA1206
Q27 2SA1015Y
Q28 2SA1015Y
Q29 2SA1206
Q30 2SC1907
Q31 2SC1907
VARIABLE CAL
VARI BAL
XS GAIN
X1 GAIN
ATTEN BAL
TRIG DC
MAIN P.B.
FL0301
J0301
J0521
J0501
P0304
TRIG SIG
TRIG SOURCE CONT(2)
X-Y SIG
DS-6411
CH-1 PRE 3
BBWDS 24013205 1



DS–6612	
CH–2 PRE	4
BBWDS 24004105	1

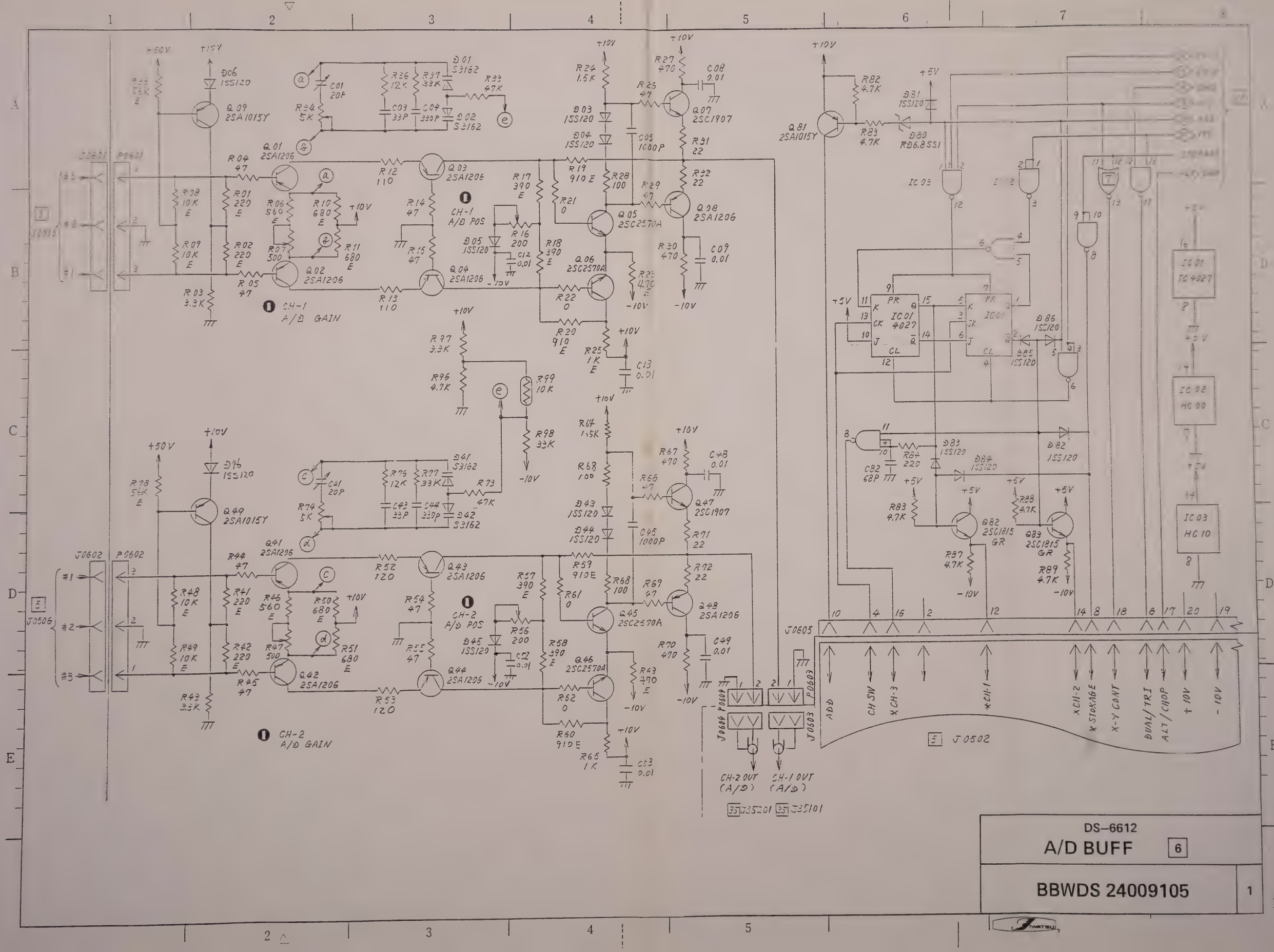


DS–6411	
CH–2 PRE	4
BBWDS 24014205	1

DS-6612/DS-6411

V. CONT 5

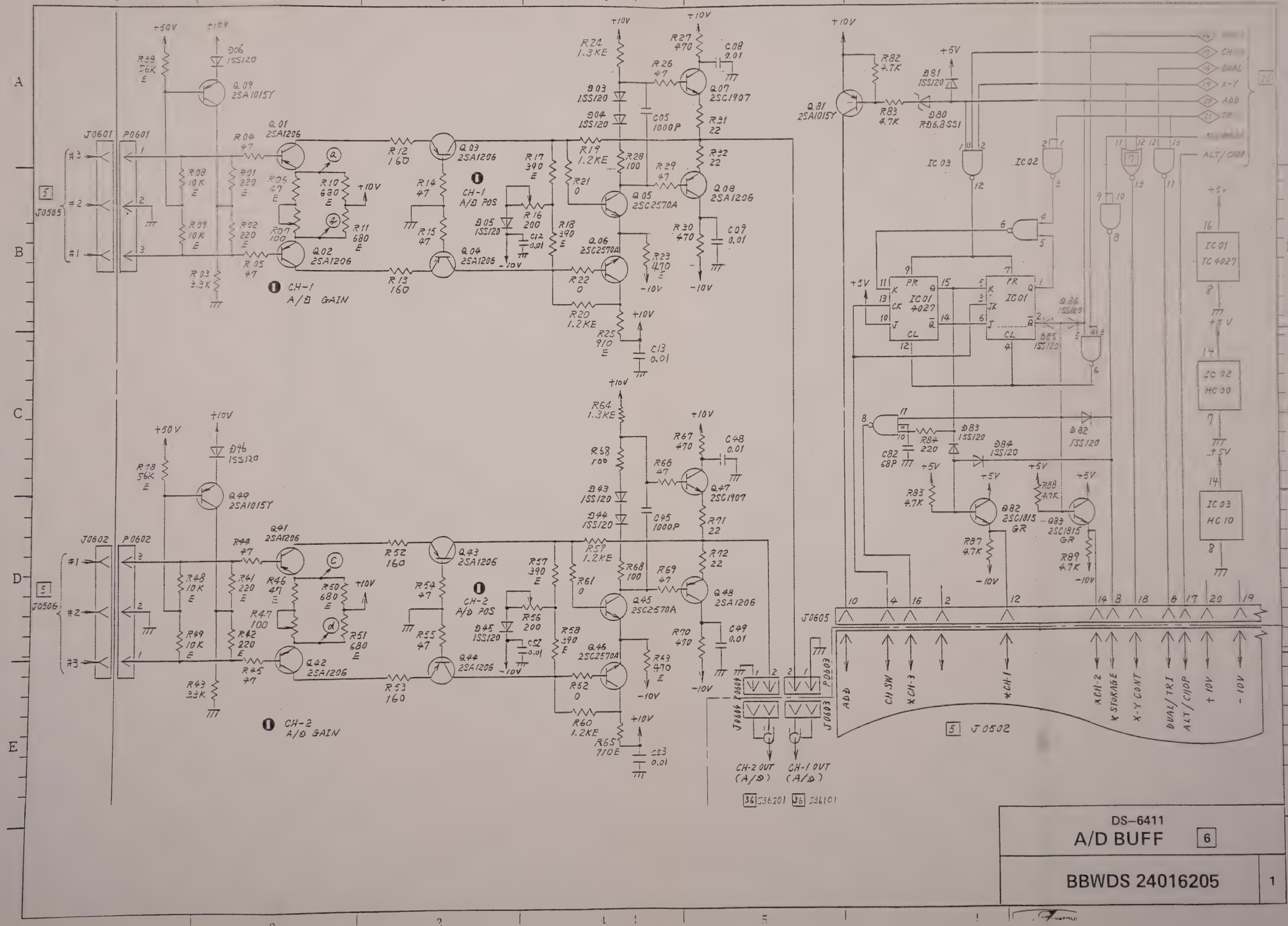
BBWDS 24005105 1



DS-6612

A/D BUFF 6

BBWDS 24009105 1


CH-1 A/D GAIN
CH-1 A/D POS
CH-2 A/D GAIN
CH-2 A/D POS
IC 01 TC 4027
IC 02 HC 00
IC 03 HC 10
CH SW
*CH-3
*CH-1
*CH-2
*STORAGE
X-Y CONT
DUAL/TRI
ALT/CHOP
+10V
-10V
ADD
CH-2 OUT (A/D)
CH-1 OUT (A/D)
DS-6411
A/D BUFF 6
BBWDS 24016205 1

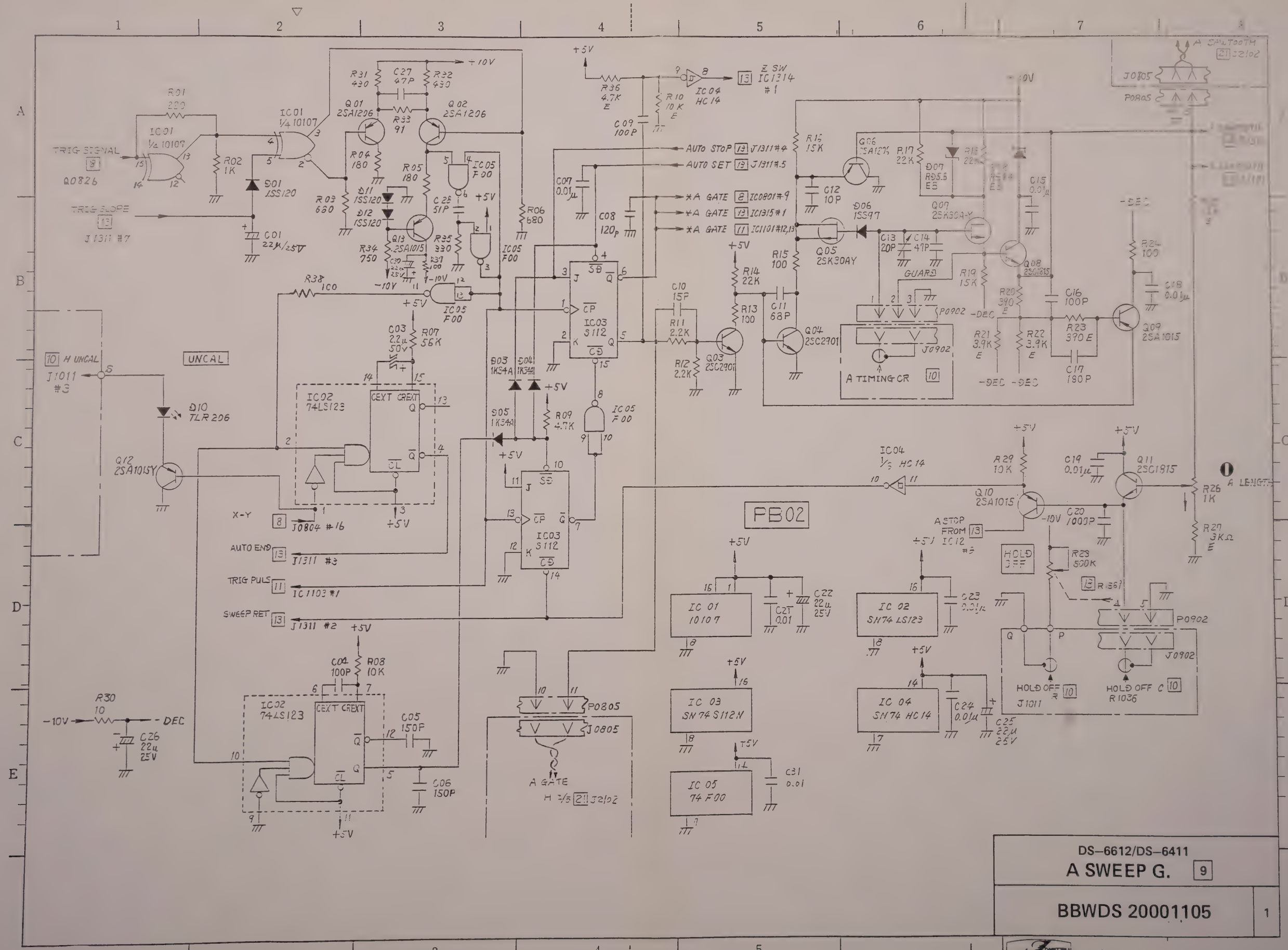
DS-6612/DS-6411

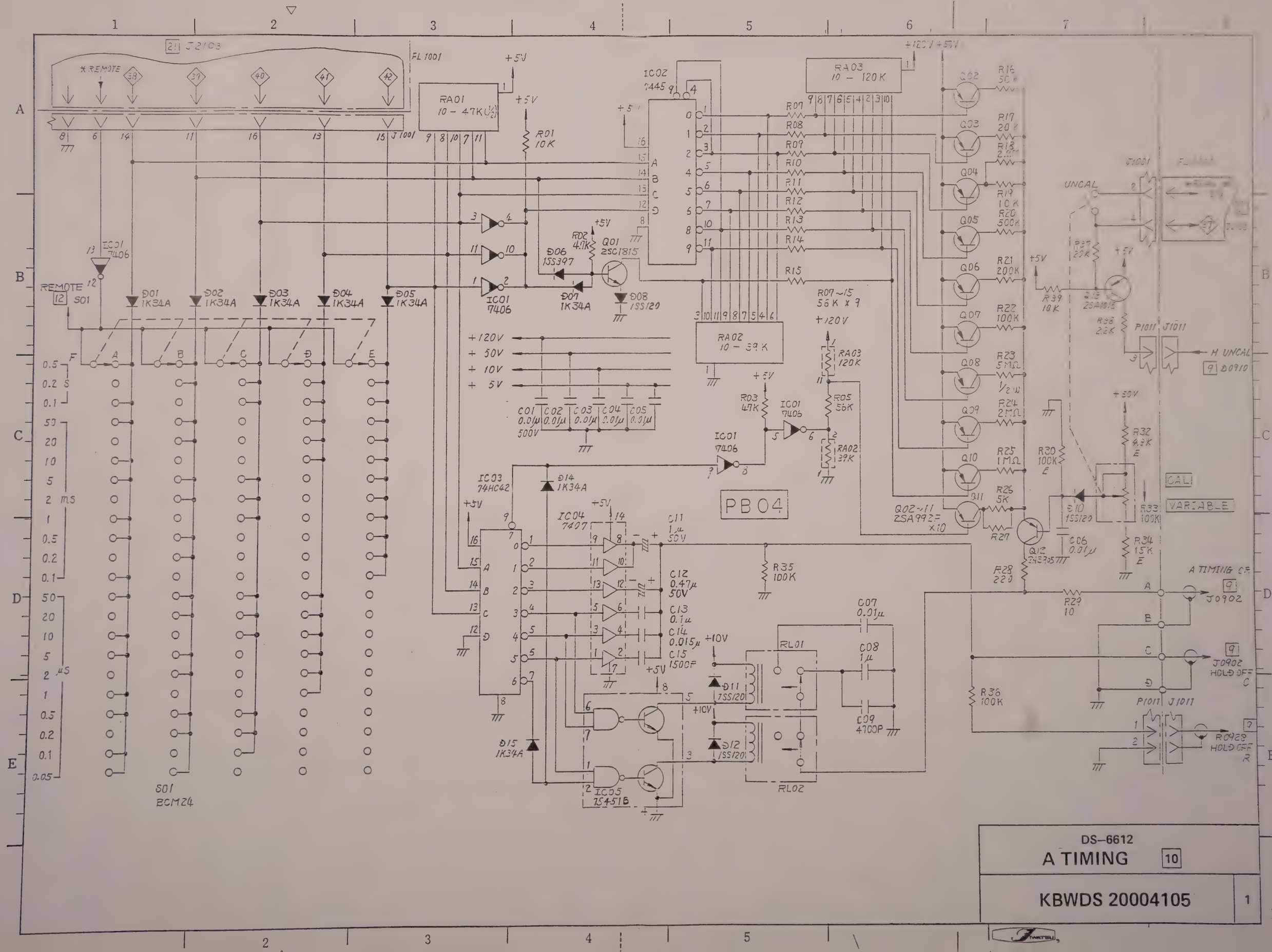
V MAIN 7

BBWDS 24010105 1

TRIG SLOPE J1311 #7 [13]
*A GATE IC0903 #6 [9]
TRIG LEVEL [13] J1311 #13
TRIG SIGNAL [9] IC0901 #15
[14] D1405 *REMOTE
IC1401#2 [14] X10MAG
[9] IC0902 #1
[14] IC1401 #5
X-Y
P0805
J0805
[21] JZ102
X-Y CONT [5]
TRIG SOURCE CONT(1) [4]
TRIG SOURCE CONT(2) [3]
LINE SIG [17]
J0804 FL0804 J0521
AC
DC
HFREJ
TV
COUPLING
SOURCE
CH1
CH2
CH3
LINE
DC
AC
CH3
EXT TRIG IN
J10 J0803 F0803
CH3 LEVEL
CH3 SIG [5] J0507
TRIG SIGNAL [3] J0304
[12] TIMING BOARD
P0801
P0802
MAIN P.B
*within ( ) is DS-6411

DS-6612/DS-6411	
TRIG G [8]	
BBWDS 34001105	1


+10V
R01 220
IC01 1/4 10107
TRIG SIGNAL
Q0826
R02 1K
TRIG SLOPE
J1311 #7
C01 22μ/25V
R31 430
C27 47P
R32 430
Q01 2SA1206
Q02 2SA1206
R33 91
R04 180
R05 180
D11 1SS120
D12 1SS120
R03 680
R06 680
IC05 F00
C28 51P
+5V
Q13 2SA1015
R35 330
R34 750
C30 22μ/25V
R37 100
-10V
R38 100
IC05 F00
C03 2.2μ 50V
R07 56K
10 H UNCAL
J1011 #3
UNCAL
D10 TLR206
IC02 74LS123
CEXT CREXT
Q12 2SA1015Y
X-Y
8 J0804 #16
AUTO END 13 J1311 #3
TRIG PULS 11 IC1103 #1
SWEEP RET 13 J1311 #2
C04 100P
R08 10K
IC02 74LS123
C05 150P
C06 150P
R30 10
C26 22μ 25V
-DEC
D03 1K34A
D04 1K34A
D05 1K34A
R09 4.7K
IC03 S112
IC05 F00
P0805
J0805
A GATE
H 3/5 21 J2102
R36 4.7K E
R10 10K E
C09 100P
IC04 HC14
13 Z SW IC1314 #1
AUTO STOP 13 J1311#4
AUTO SET 13 J1311#5
*A GATE 8 IC0801#9
*A GATE 13 IC1315#1
*A GATE 11 IC1101#12,13
C07 0.01μ
C08 120P
R14 22K
R13 100
C10 15P
R11 2.2K
R12 2.2K
Q03 2SC2901
R15 15K
C12 10P
Q06 2SA1213
R17 22K
D07 RD5.6 EB
R18 22K
D06 1SS97
Q05 2SK30AY
Q07 2SK30A-Y
C13 20P
C14 47P
GUARD
C15 0.01μ
R19 15K
Q08 2SC1815
R20 390 E
C16 100P
R24 100
C18 0.01μ
Q09 2SA1015
P0902
J0902
A TIMING CR 10
R21 3.9K E
R22 3.9K E
R23 390 E
C17 180P
-DEC -DEC
C11 68P
Q04 2SC2901
IC04 1/6 HC14
R29 10K
C19 0.01μ
Q11 2SC1815
R26 1K
R27 3KΩ E
A LENGTH
Q10 2SA1015
A STOP FROM 13 IC12 #8
-10V
C20 1000P
HOLD OFF
R28 500K
13 R1367
P0902
J0902
HOLD OFF R 10 J1011
HOLD OFF C 10 R1036
PB02
IC 01 10107
C22 22μ 25V
C21 0.01
IC 02 SN74LS123
C23 0.01μ
IC 03 SN74S112N
IC 04 SN74HC14
C24 0.01μ
C25 22μ 25V
IC 05 74F00
C31 0.01
DS-6612/DS-6411
A SWEEP G. 9
BBWDS 20001105 1

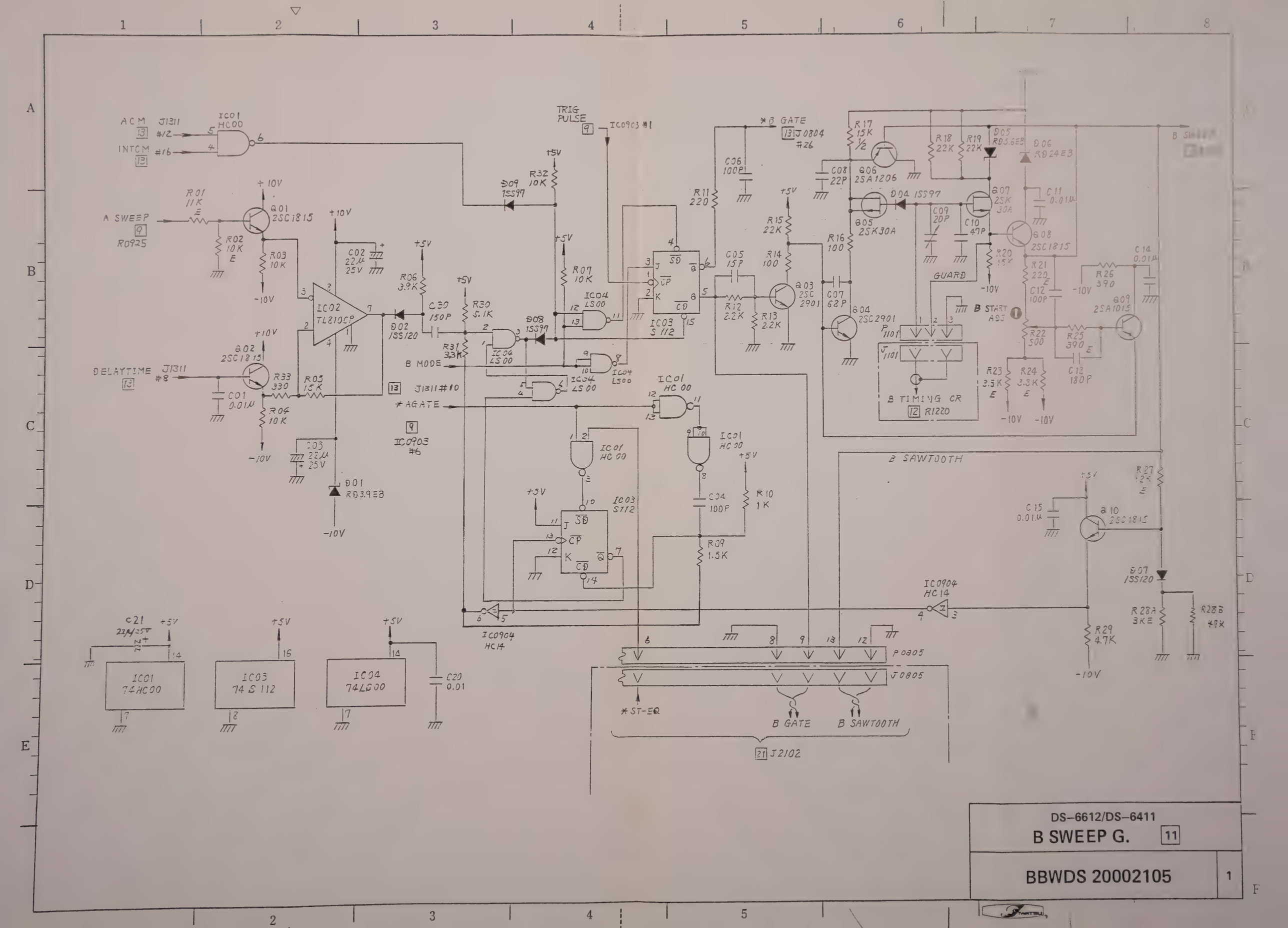

J2103
REMOTE
FL1001
RA01 10 - 47K
R01 10K
IC01 7406
IC02 7445
RA03 10 - 120K
RA02 10 - 39K
R07~15 56K x 9
+120V
+50V
+10V
+5V
D01 1K34A
D02 1K34A
D03 1K34A
D04 1K34A
D05 1K34A
D06 1SS97
D07 1K34A
D08 1SS120
Q01 2SC1815
RD2 4.7K
S01 BCM24
C01 0.01μ 500V
C02 0.01μ
C03 0.01μ
C04 0.01μ
C05 0.1μ
IC03 74HC42
IC04 7407
IC05 TA4516
D14 1K34A
D15 1K34A
C11 1μ 50V
C12 0.47μ 50V
C13 0.1μ
C14 0.015μ
C15 1500P
C07 0.01μ
C08 1μ
C09 4700P
D11 1SS120
D12 1SS120
RL01
RL02
RA03 120K
R05 56K
RA02 39K
R03 47K
Q02 R16 50
Q03 R17 20
Q04 R19 10K R20 500K
Q05 RZ1 200K
Q06 RZ2 100K
Q07 R23 5MΩ ½W
Q08 R24 2MΩ
Q09 R25 1MΩ
Q10 R30 100K E
Q11 R26 5K R27
Q12 2SA992E
Q02~11 2SA992E x10
R28 220
R29 10
R35 100K
R36 100K
R39 10K
R37 20K
R38 2.2K
Q13 2SA1815
R32 4.3K E
R33 100K VARIABLE
R34 15K E
D10 1SS120
C06 0.01μ
UNCAL
CAL
H UNCAL
A TIMING OFF
HOLD OFF C
HOLD OFF R
P1011 J1011
J1001
J0902
J0910
J0928
PB04
DS-6612
A TIMING 10
KBWDS 20004105 1

PB04

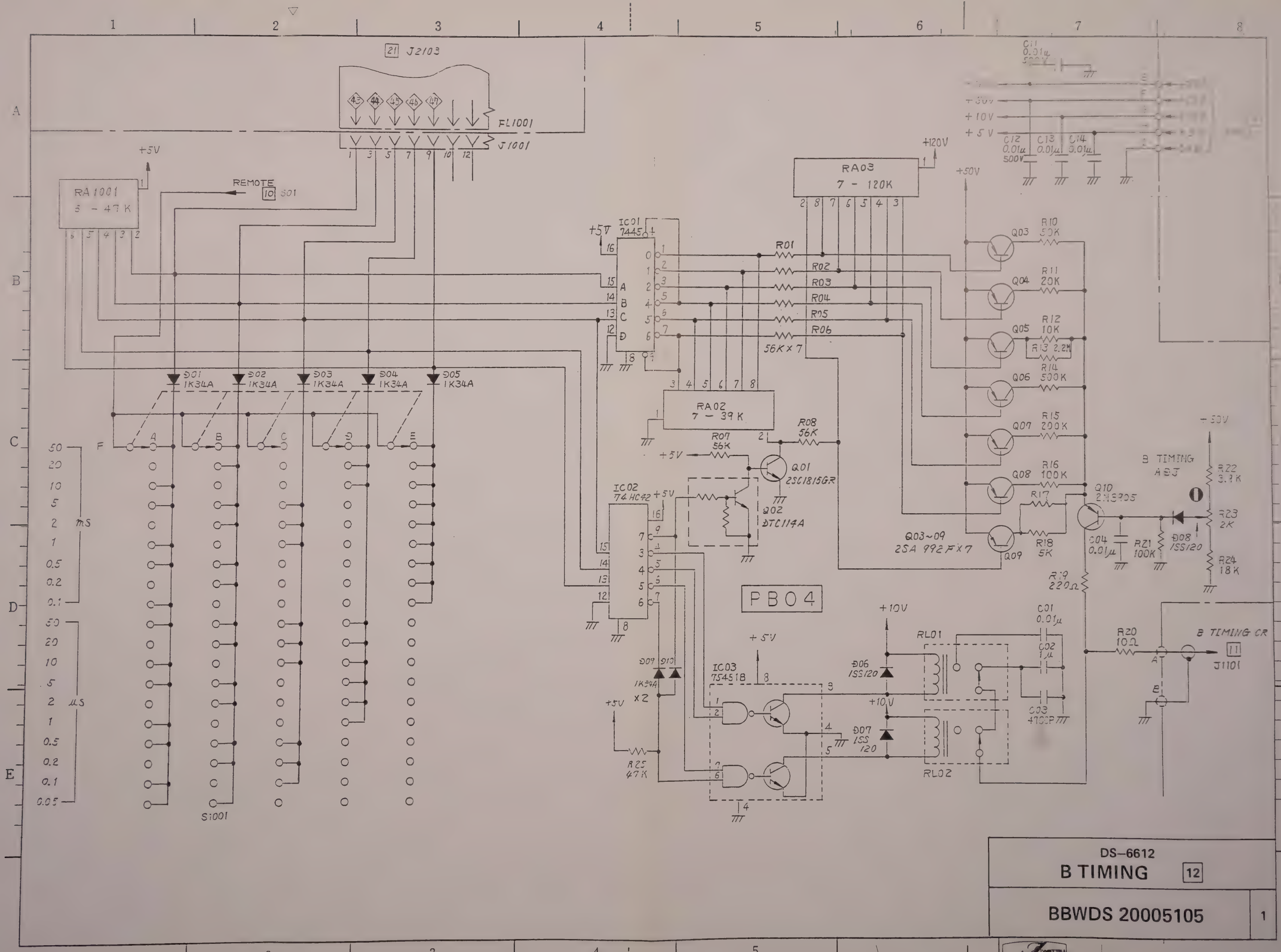
DS-6411

A TIMING 10

BBWDS 20007205 1



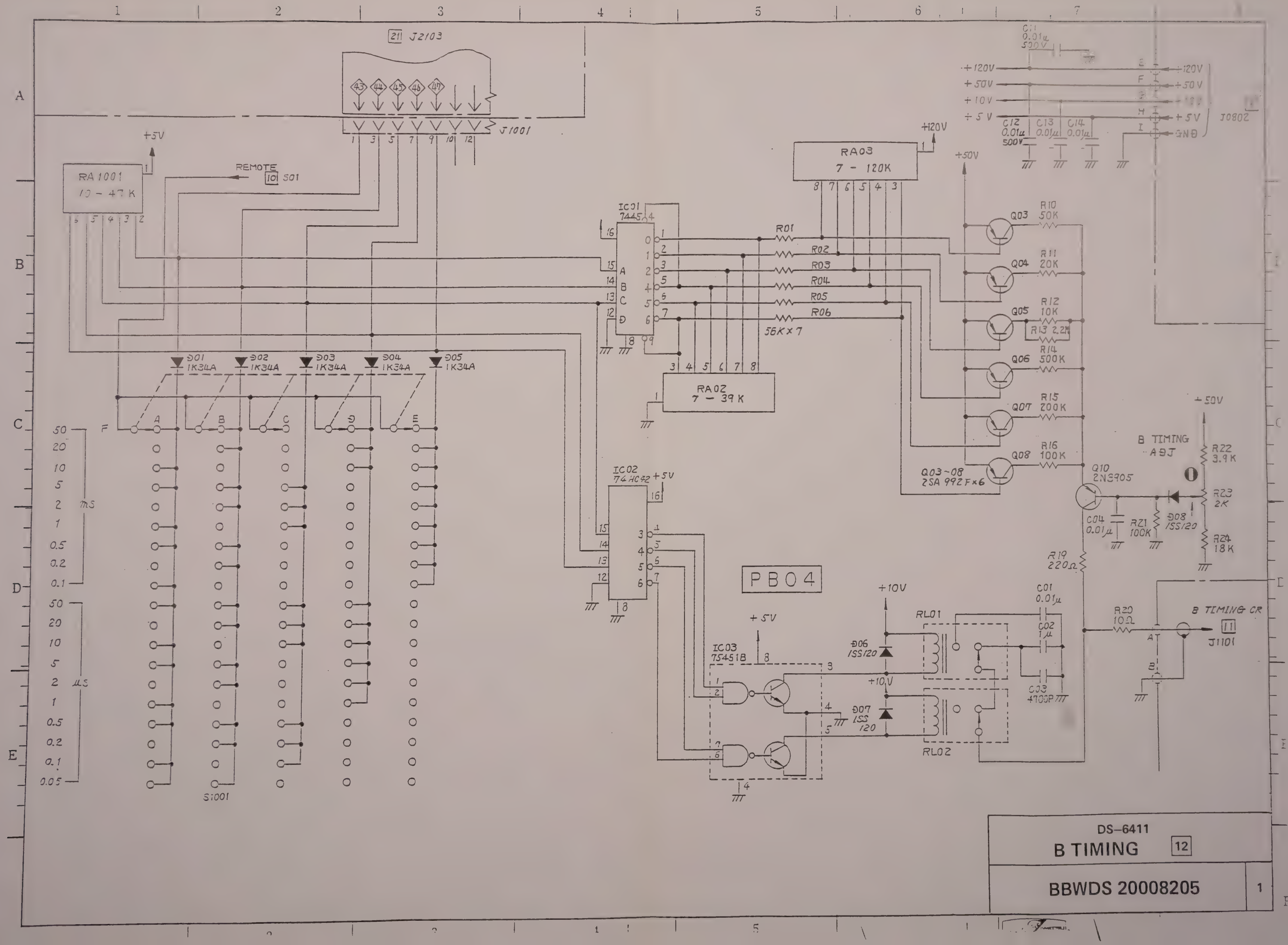
DS–6612/DS–6411	
B SWEEP G. [11]	
BBWDS 20002105	1

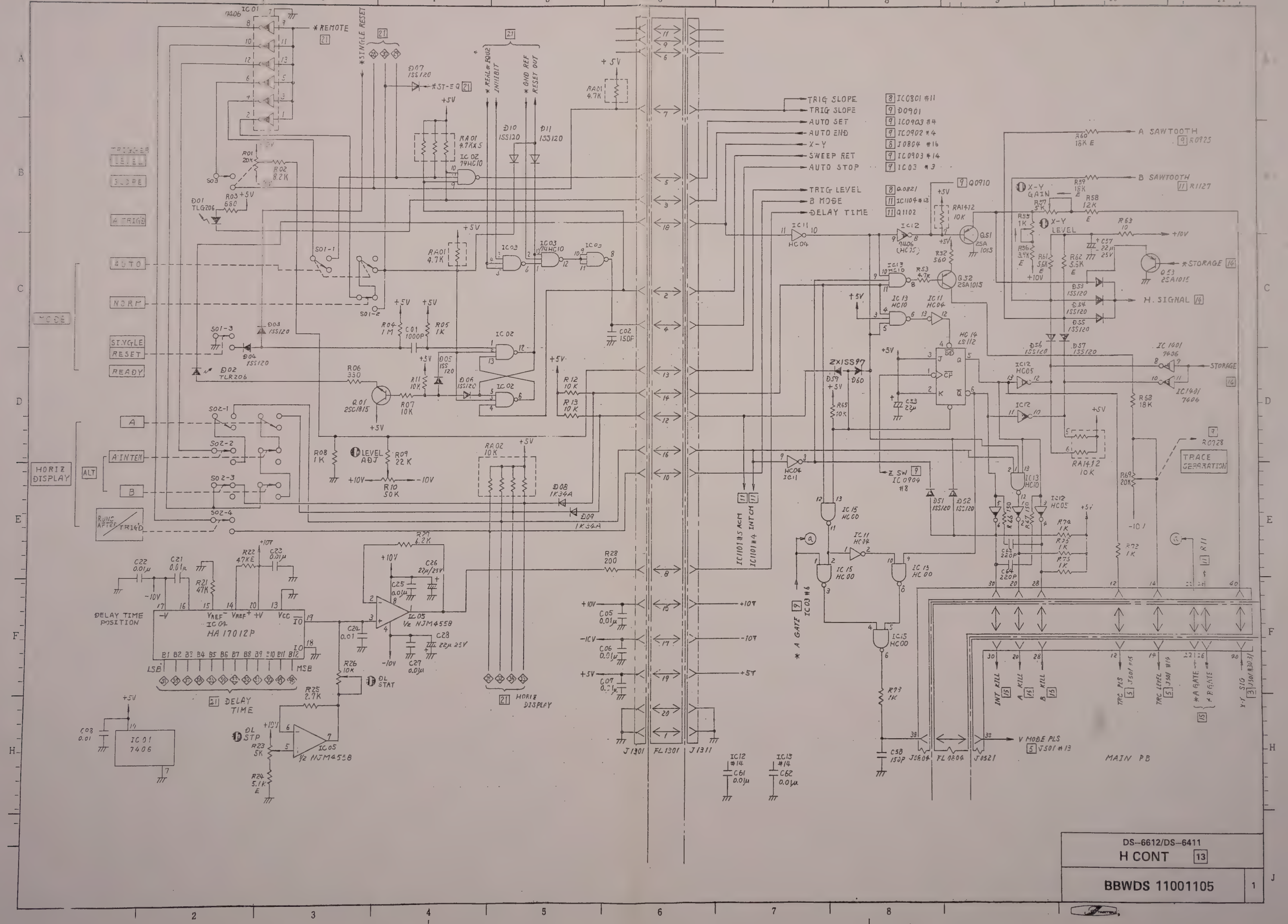


DS-6612

B TIMING 12

BBWDS 20005105 | 1


211 J2103
43 44 45 46 47
J1001
1 3 5 7 9 10 12
+5V
RA1001
10 - 47K
REMOTE
10 S01
D01 1K34A
D02 1K34A
D03 1K34A
D04 1K34A
D05 1K34A
A B C D E F
50 20 10 5 2 ms 1 0.5 0.2 0.1
50 20 10 5 2 μs 1 0.5 0.2 0.1 0.05
S1001
IC01 74LS47
RA02 7 - 39K
R01 R02 R03 R04 R05 R06
56K×7
RA03 7 - 120K
+120V
+50V
+10V
+5V
GND
J1080Z
C11 0.01μ 500V
C12 0.01μ 500V
C13 0.01μ
C14 0.01μ
Q03 R10 50K
Q04 R11 20K
Q05 R12 10K
R13 2.2K
Q06 R14 500K
Q07 R15 200K
Q08 R16 100K
Q03~08 2SA 992F×6
Q10 2N3905
B TIMING ADJ
R22 3.9K
R23 2K
R24 18K
C04 0.01μ
R21 100K
D08 1SS120
R19 220Ω
IC02 74HC42
PB04
IC03 75451B
D06 1SS120
D07 1SS 120
RL01
RL02
C01 0.01μ
C02 1μ
C03 4700P
R20 10Ω
B TIMING CR
J1101
DS-6411
B TIMING 12
BBWDS 20008205 1

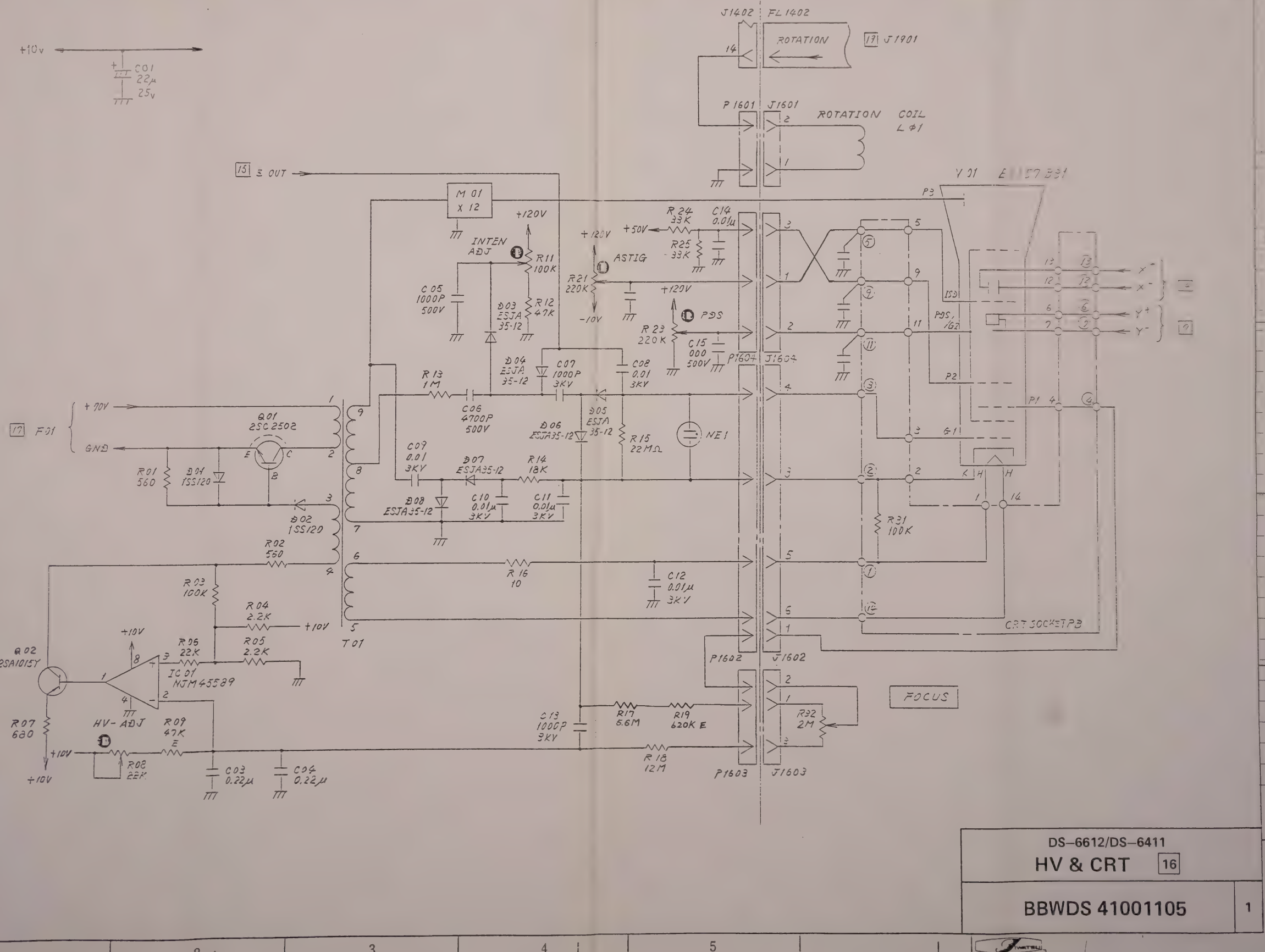

MODE
TRIGGER LEVEL
SLOPE
A TRIG'D
AUTO
NORM
SINGLE RESET
READY
A
A INTEN
B
RUNS AFTER TRIG'D
ALT
HORIZ DISPLAY
* REMOTE
* SINGLE RESET
* ST-B Q
* REAL-TIME BASE INHIBIT
* GND REF RESET OUT
+5V
-10V
+10V
TRIG SLOPE
TRIG SLOPE
AUTO SET
AUTO END
X-Y
SWEEP RET
AUTO STOP
TRIG LEVEL
B MODE
DELAY TIME
A SAWTOOTH
B SAWTOOTH
X-Y GAIN
X-Y LEVEL
* STORAGE
H. SIGNAL
STORAGE
TRACE SEPARATION
DELAY TIME POSITION
DELAY TIME
DL STAT
DL STP
HORIZ DISPLAY
* A GATE
INT KILL
A KILL
B KILL
TRC PLS
TRC LEVEL
* A GATE
* B GATE
X-Y SIG
V MODE PLS
MAIN PB
J1301
FL1301
J1311
FL0804
J0804
J0521
DS-6612/DS-6411
H CONT 13
BBWDS 11001105
1

DS–6612/DS–6411

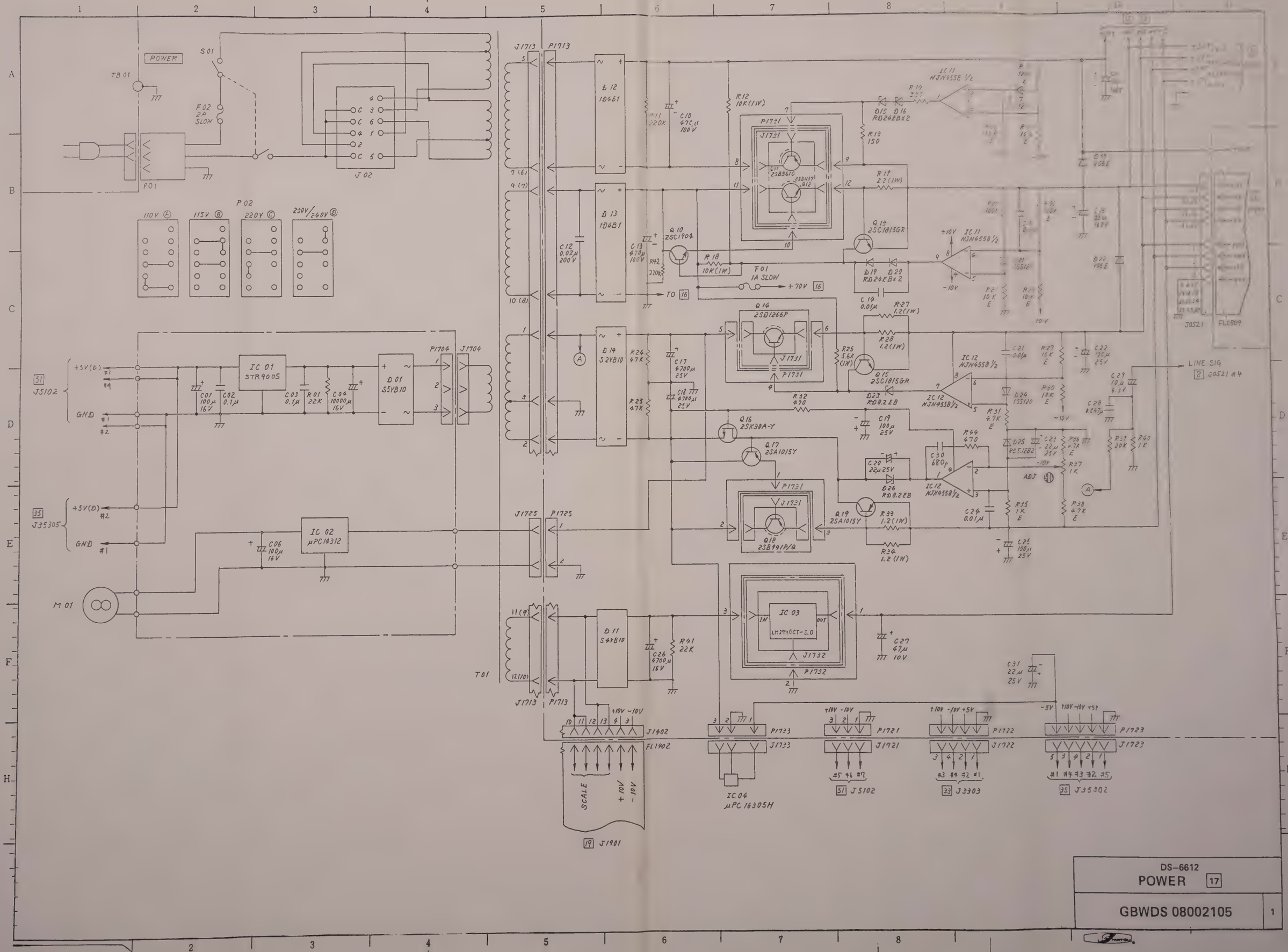
H AMP 14

KBWDS 24007105 | 1

Z AXIS INPUT
J10
J1502
P1502
19 J1901
FL1402
J1402
STORAGE-Z
SIG INTEN
CHA INTEN
*CHA OFF
+10V
-10V
18
16
19
20
C12 22μ 25V
C13 22μ 25V
R13 68K
R12 12K
R01 8.2K
R02 8.2K
R03 68K
R04 8.2K
R05 16K
R06 56K
R07 1.8K
R08 3.2K
R09 33K
R10 10K
C10 0.01
R11 3.6K
R44 4.3K
R45 16K
R46 620
R47 16K
R48 11K
R42 10K
R43 10K
R14 8.2K
R15 3.9K
R16 2.4K
R17K 7.5K
C03 0.01μ
R19 2.4K
C04 0.01μ
R20 7.5K
R22 1.5K
R21 5.6K
R41 33K
R24 100
R25 5.6K
R26 2K
R27 2.4K
R28 2.4K
R29 220K
R30 0
R31 1.2K
R32 470
R33 39K E
R34 27K E
C06 0.5P 500V
C07 0.022μ 200V
R35 180
R36 100K E
R37 3.3K
R38 680
R39 68K E
C08 0.047 200V
C09 0.1μ
C11 22μ/25V
C12 0.1μ
D01~D18 1SS120
D20 1SS120
D21 1SS120
D22 1SS120
D23 RD5.6ZB
D24 1SS120
D25 1SS120
D26 1SS120
Q01 2SC1815
Q02 2SC1815
Q03 2SC1815
Q04 2SC1815
Q05 2SC1815
Q06 2SC1815
Q07 2SC1815
Q08 2SC1815
Q09 2SD668AC
Q10 2SB648AC
IC01 74HC05
IC01 HC05
*A GATE
*B GATE
INT KILL
A KILL
B KILL
13 J0521
5 CHOP BLK
X-Y CONT
5 J0501 #32
J1501
P1501
STORAGE
23 J3305
TRC Z BLK
ST A INT
BLK SMOOTH
CHA EN
CHA BLK
*CHA OFF
N.C.
+120V
+5V
+5v
16 Z OUT
DS-6612/DS-6411
Z AMP 15
BBWDS 24011105
1
IWATSU

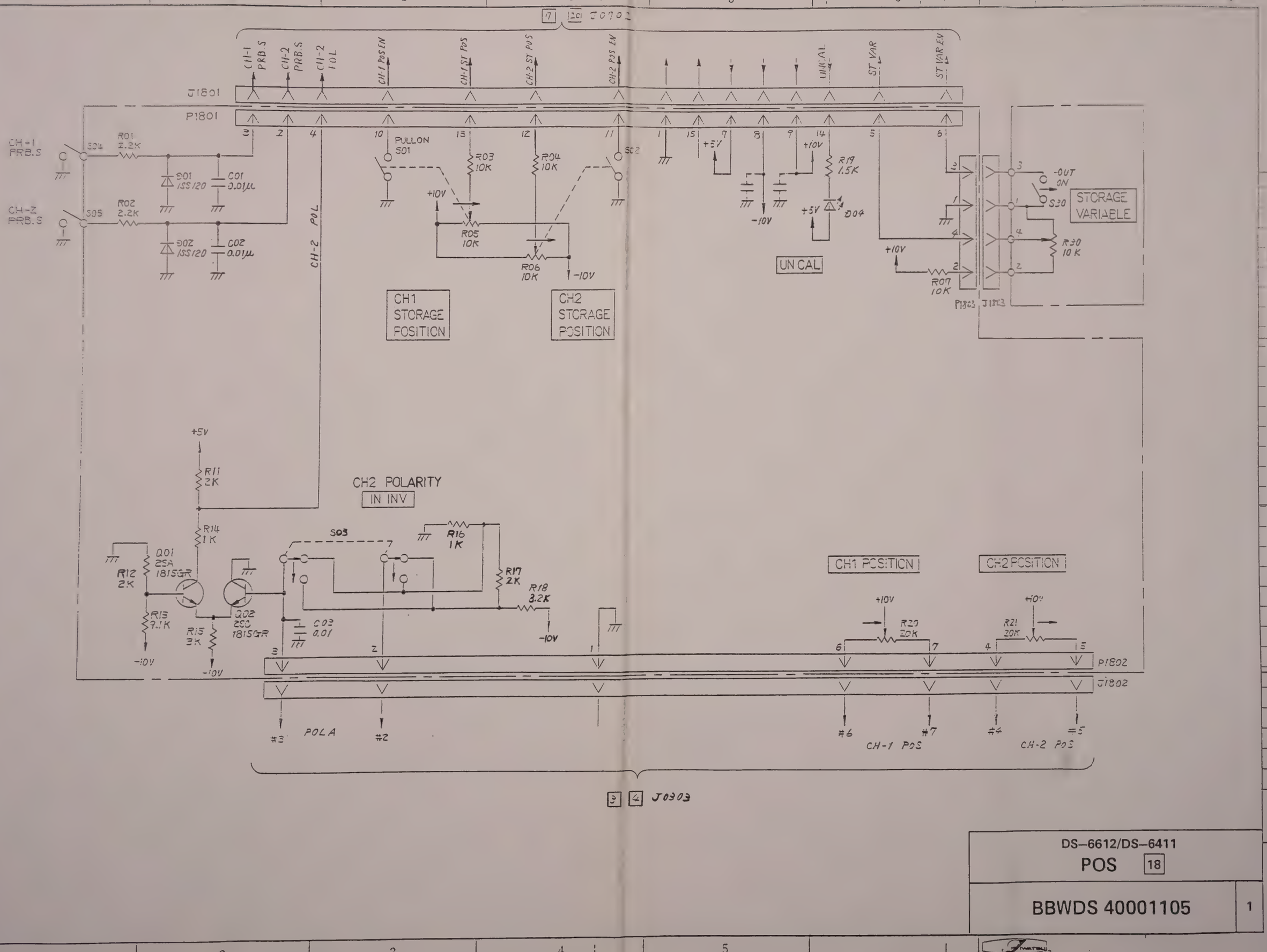


DS–6612/DS–6411	
HV & CRT 16	
BBWDS 41001105	1

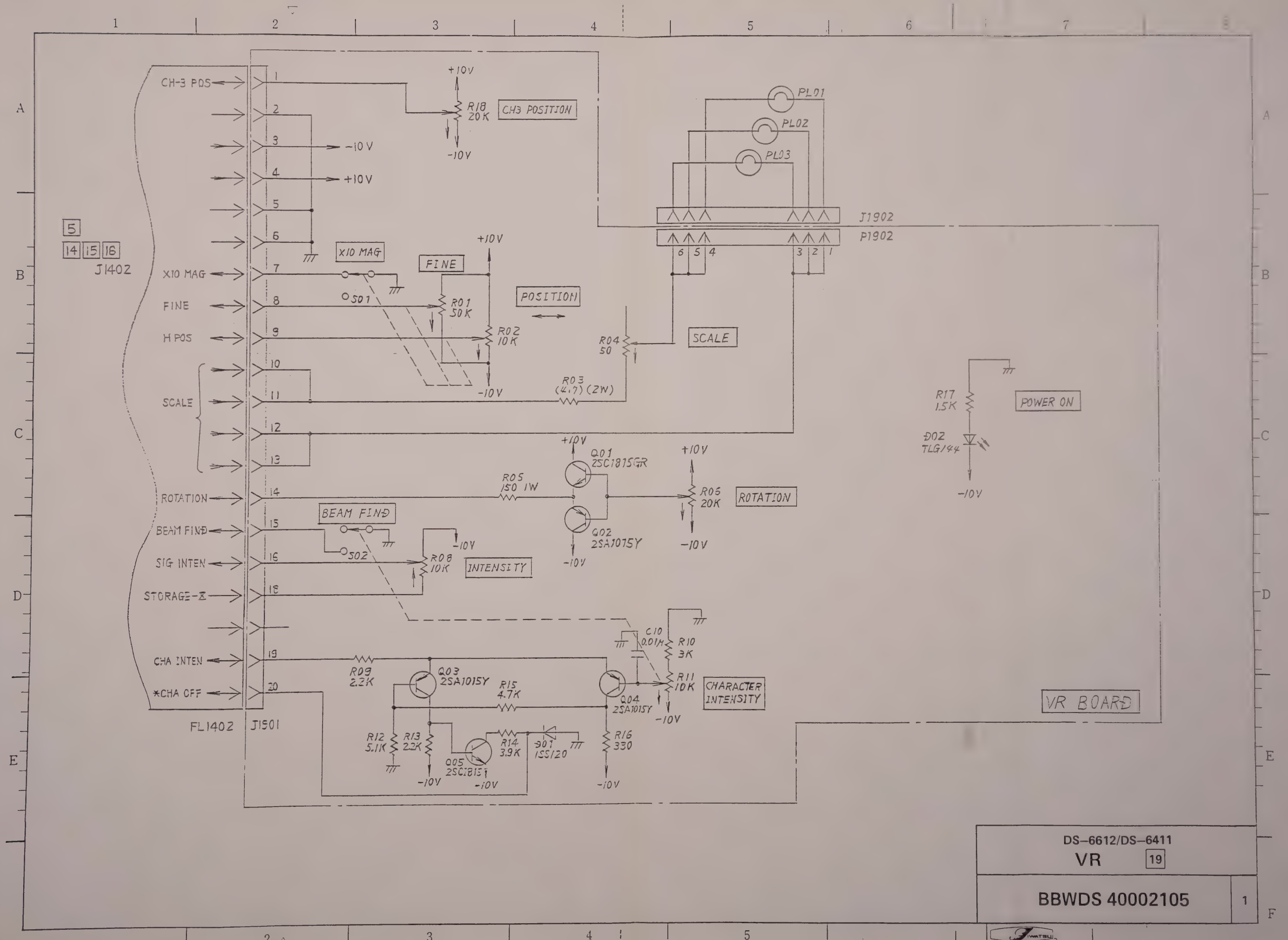


DS–6612	
POWER	17
GBWDS 08002105	1

POWER
S01
TB01
F02 2A SLOW
J02
P02
110V (A)
115V (B)
220V (C)
230V/240V (D)
51 J5102
+5V(D) #4
#3
GND #2
#1
IC 01 STR90D5
C01 100μ 16V
C02 0.1μ
C03 0.1μ
R01 22K
C04 10000μ 16V
D01 S5VB10
P1704
J1704
35 J3630C2
+5V(D) #2
GND #1
IC 02 μPC14312
C06 100μ 16V
M01
J1725
P1725
T01
J1713
P1713
D11 S4VB10
C26 4700μ 16V
R41 22K
+10V -10V
J1402
FL1402
SCALE
+10V
-10V
19 J1901
D12 1D4B1
D13 1D4B1
D14 S2VB10
R11 220K
C10 470μ 100V
C12 0.02μ 200V
C13 470μ 100V
Q10 2SC1904
R18 10K(1W)
R42 220K
TO 16
F11 1A SLOW
+70V 16
R12 10K(1W)
P1731
J1731
Q11 2SB861C
2SD1177 B12
R19 22(1W)
D15 D16 RD26EBx2
R13 150
IC11 NJM4558 1/2
R14 330
R16 120K E
D17 1SS120
R15 10K E
R17 10K E
-10V
+10V
D18 V06E
Q13 2SC1815GR
D19 D20 RD26EBx2
C19 0.01μ
R27 1.2(1W)
R28 1.2(1M)
Q14 2SD1266P/Q
R26 5.6K (1W)
Q15 2SC1815GR
D23 RD8.2EB
R32 470
C17 4700μ 25V
C18 4700μ 25V
R24 47K
R25 47K
Q16 2SK30A-Y
Q17 2SA1015Y
C20 22μ 25V
D26 RD8.2EB
Q19 2SA1015Y
R33 1.2(1M)
R34 1.2(1M)
Q18 2SB941P/Q
C30
R44 470
IC12 NJM4558 1/2
C24 0.01μ
R35 1K E
R38 4.7K E
C25 100μ 25V
ADJ
R20 100K
C15 0.01μ
R22 100K E
C16 33μ 160V
D21 1SS120
R21 10K E
R23 10K E
D22 V06E
C21 0.01μ
R29 10K E
C22 100μ 25V
D24 1SS120
R30 10K E
R31 4.7K E
C23 22μ 25V
D25 RD5.1EB2
R36 4.7K E
R37 1K
C29 10μ 6.3V
C28 0.047μ
R39 20K
R40 1K
LINE SIG
9 J0521 #4
J0704
J0521
IC03 LM2940CT -5.0
J1732
P1732
C27 47μ 10V
P1721
J1721
P1722
J1722
P1724
J1724
51 J5102
33 J3303
36 J3606
DS-6411
POWER 17
GBWDS 08007105 1



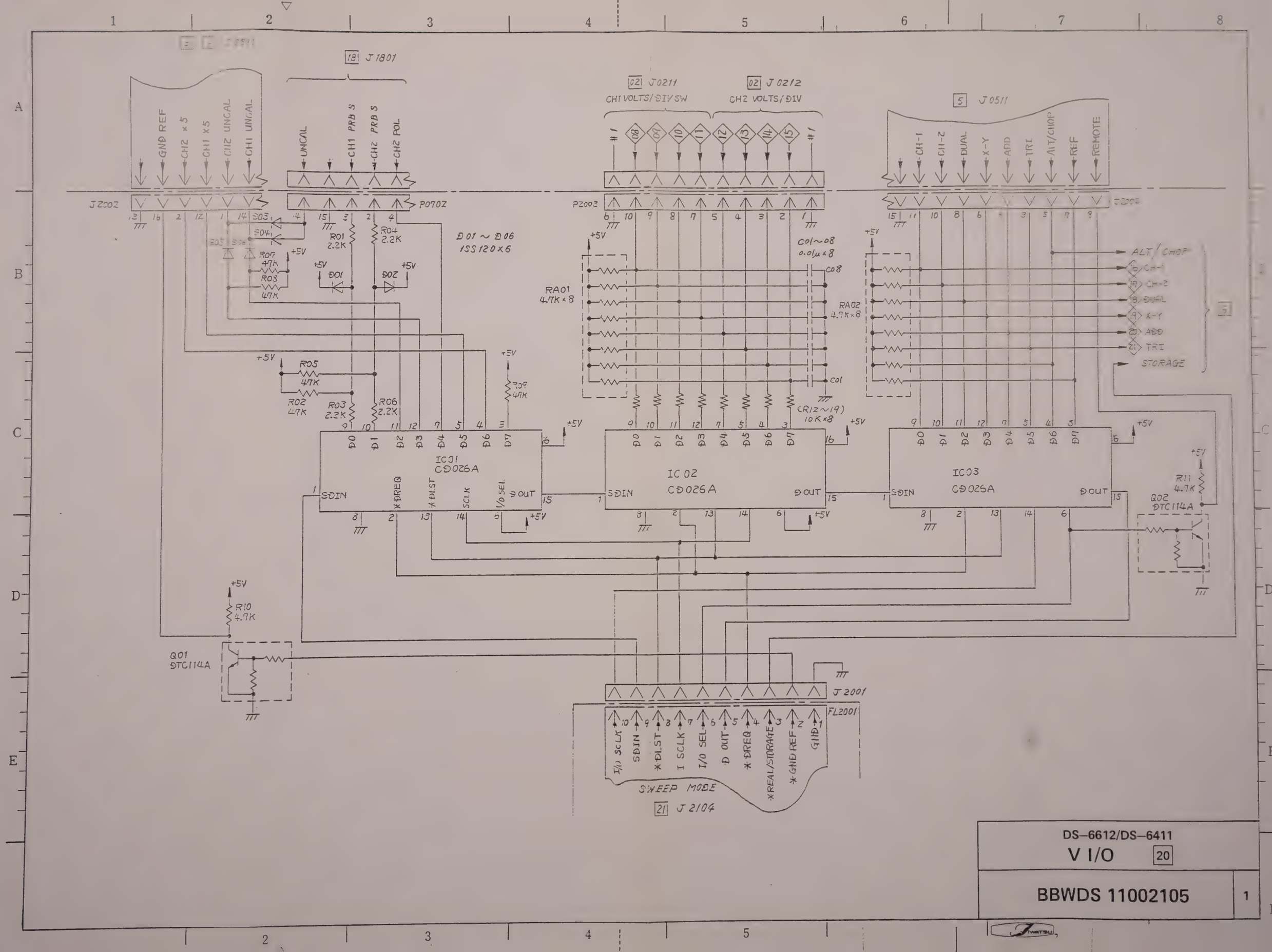
DS–6612/DS–6411 POS 18	
BBWDS 40001105	1



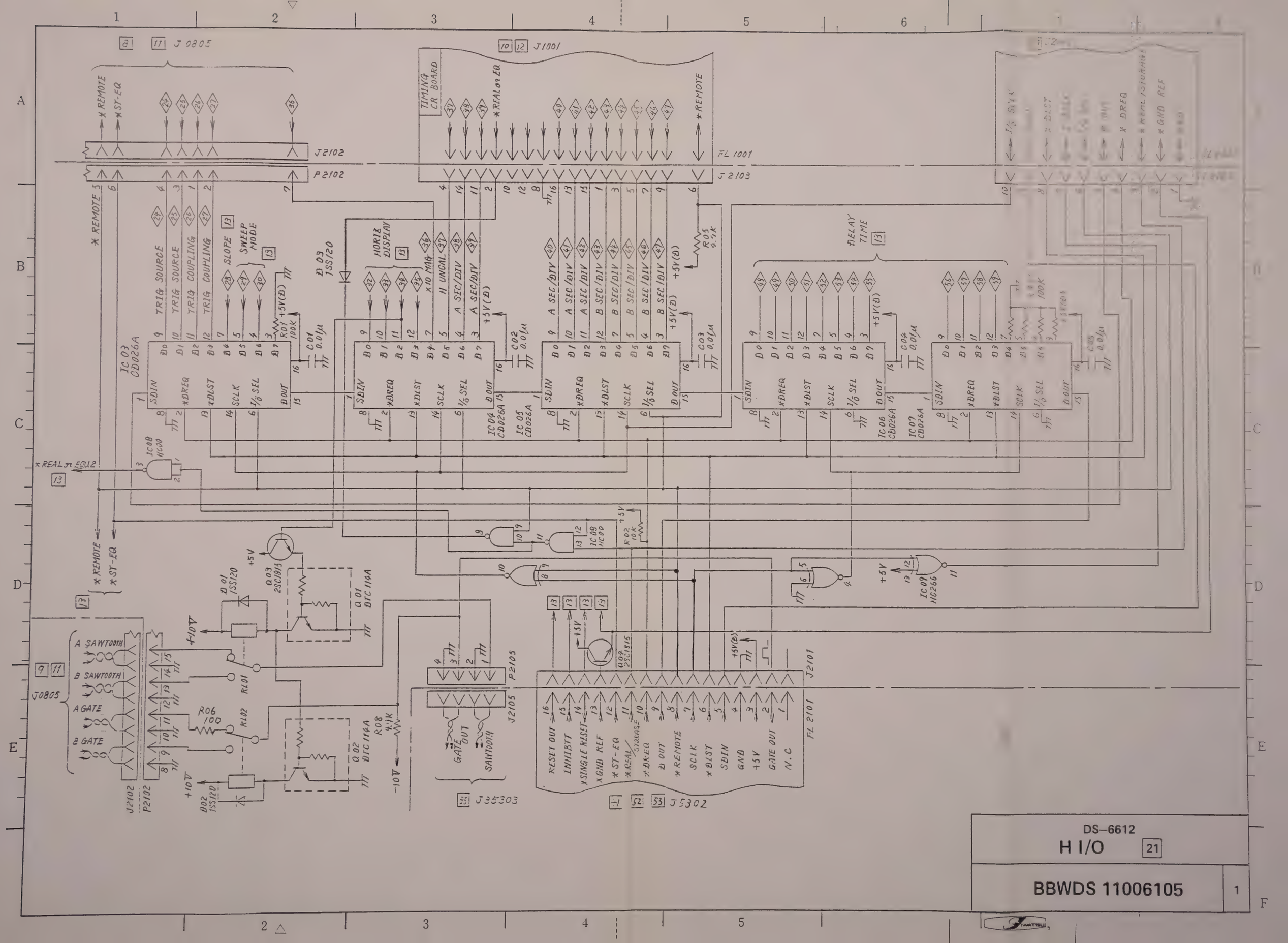
DS–6612/DS–6411

VR 19

BBWDS 40002105 | 1



DS–6612/DS–6411	
V I/O 20	
BBWDS 11002105	1



DS–6612

H I/O 21

BBWDS 11006105 | 1

DS-6411
H I/O
21

BBWDS 11012105

1

J3001

TRCSHBLK (2-6G)

1XCOUNT (2-6H)

#TRCREQ (2-2F)

M-D&P CK (P3001-33)
#DISPPEN (P3001-30)
#DISPDMA (P3001-35)
#10WE2 (P3001-36)
D0 (P3001-15)
D1 (P3001-16)
D2 (P3001-17)
D3 (P3001-18)
D4 (P3001-28)
D5 (P3001-30)
D6 (P3001-31)
D7 (P3001-32)

RA1-1 100K
RA1-2 100K
RA1-3 100K
RA1-4 100K
RA1-5 100K
RA1-6 100K

DB0 (2-1D)
DB1 (2-1D)
DB2 (2-1D)
DB3 (2-1D)
DB4 (2-1B)
DB5 (2-2B)
DB6 (2-2B)
DB7 (2-1B)

A0 (P3001-20)
A1 (P3001-21)
A2 (P3001-22)
A3 (P3001-23)
A4 (P3001-24)

AB0 (2-1B)
AB1 (2-2B)
AB2 (2-2B)
AB3 (2-1B)

#DISPEN (P3001-34)

HCDP (2-2F)
#8253 (2-6H)
#BLKMEM (2-2F)

GONOEN (2-9E)
GONOJG (2-9E)
GONOMO (2-9E)
PENUP (2-9E)
PENRC (2-2F)

IC3B HCS74
IC3C HCS74
IC2B HC151
IC2A HC157
IC3L HC244
IC3K-2 HC32
IC1L-1 HC32
IC1L-2 HC32
IC4C MB8464A
IC3E-1 HC139
IC3F-2 HC139
IC2G-2 HC32
IC1E-2 HC02
IC1B-1 HC02
IC1J HC157
IC3D HCS74
IC5C HCS74
IC4F HC244
IC1E-4 HC02
IC1E-3 HC02
IC1D-2 HC123
R1 4.7K
C3 10P
IC1C-2 HC02
IC1F-1 HC74
IC1G-1 HC04
IC1D-1 HC123
R2 10K
C4 2200P
IC1H HC157
IC2E-1 HC393
IC1K HC164
IC1L-3 HC32
IC1G-2 HC04
IC1L-4 HC32
IC1C-1 HC32
IC2B-2 HC393
IC2D-1 HC393
IC2D-2 HC393
IC1A HC157
IC1F-2 HC74
IC2K-2 HC32
IC2L-1 HC08
IC5C HCS74
IC4B HCS74
IC1B-2 HC08
IC1C-4 HC02
IC1C-3 HC02
IC1B-3 HC08
IC2K-1 HC32
IC2L-3 HC08
IC2L-4 HC08

AA (TF)
AC (XG)
AB (5F)
AA (5B)
AC (6C)

YD0 (2-1A)
YD1 (2-1A)
YD2 (2-1A)
YD3 (2-1A)
YD4 (2-1A)
YD5 (2-1B)
YD6 (2-1B)
YD7 (2-1B)
YD8 (2-1B)
YD9 (2-1B)
YD10 (2-1B)
YD11 (2-1B)

XD0 (2-8A)
XD1 (2-8A)
XD2 (2-8A)
XD3 (2-8A)
XD4 (2-8A)
XD5 (2-8B)
XD6 (2-8B)
XD7 (2-8B)
XD8 (2-8B)
XD9 (2-8B)
XD10 (2-8B)
XD11 (2-8B)

+5V (P3001-13)
+5V (P3001-14)
GND (P3001-17)
GND (P3001-18)
GND (P3001-19)

1KC ADDR

#RESET (P3001-33)
TRCEN (P3001-40)
ROLLBLK (P3001-14)
TRCBLK (2-9A)

BRST (2-2D)
TRCEN (2-2F)

A0 (2-3G)
A1 (2-3G)
A2 (2-3G)
A3 (2-3G)
A4 (2-3G)
A5 (2-3G)
A6 (2-3G)
A7 (2-3G)
A8 (2-3G)
A9 (2-3G)
A10 (2-2H)
A11 (2-2H)

R3 4.7K
D2 1SS120
C6 56P
R5 100K

#STORAGE (2-9E)
(400K) MSCK (P3001-10)
1KCK (2-2B)
#TRCEN (2-2F)
NPPR (2-2F)
CHASTART (2-2F)

GATE3 (2-6K)
MSCL (P3001-11)
RCH ROLL (P3001-15)
RCH ROLL (P3001-12)
#RCH1EN (2-9A)
#RCH2EN (2-9A)

1/2

DS-6612/DS-6411
CHA-A 30

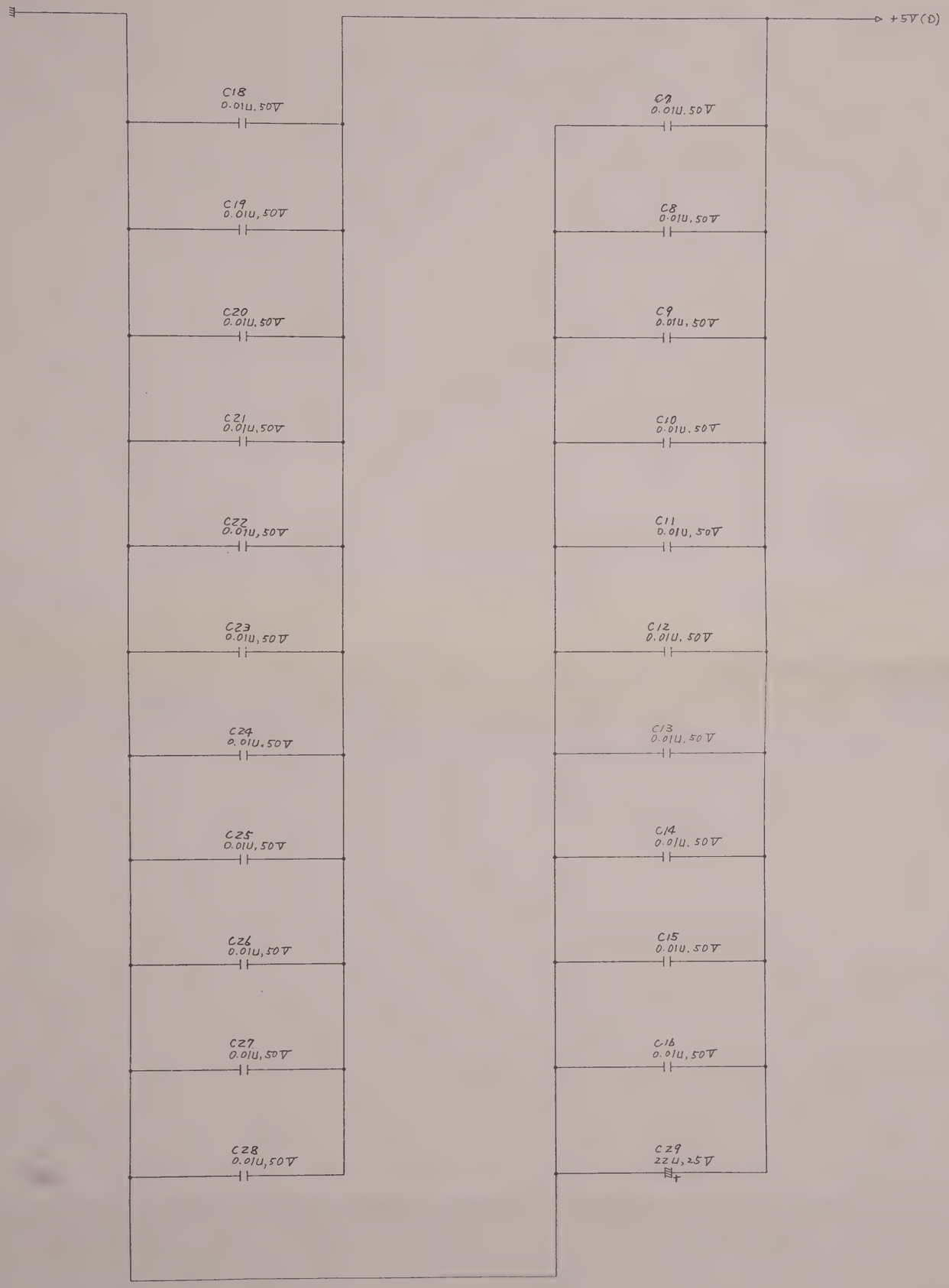
BBWDS 10008105 1

J3101

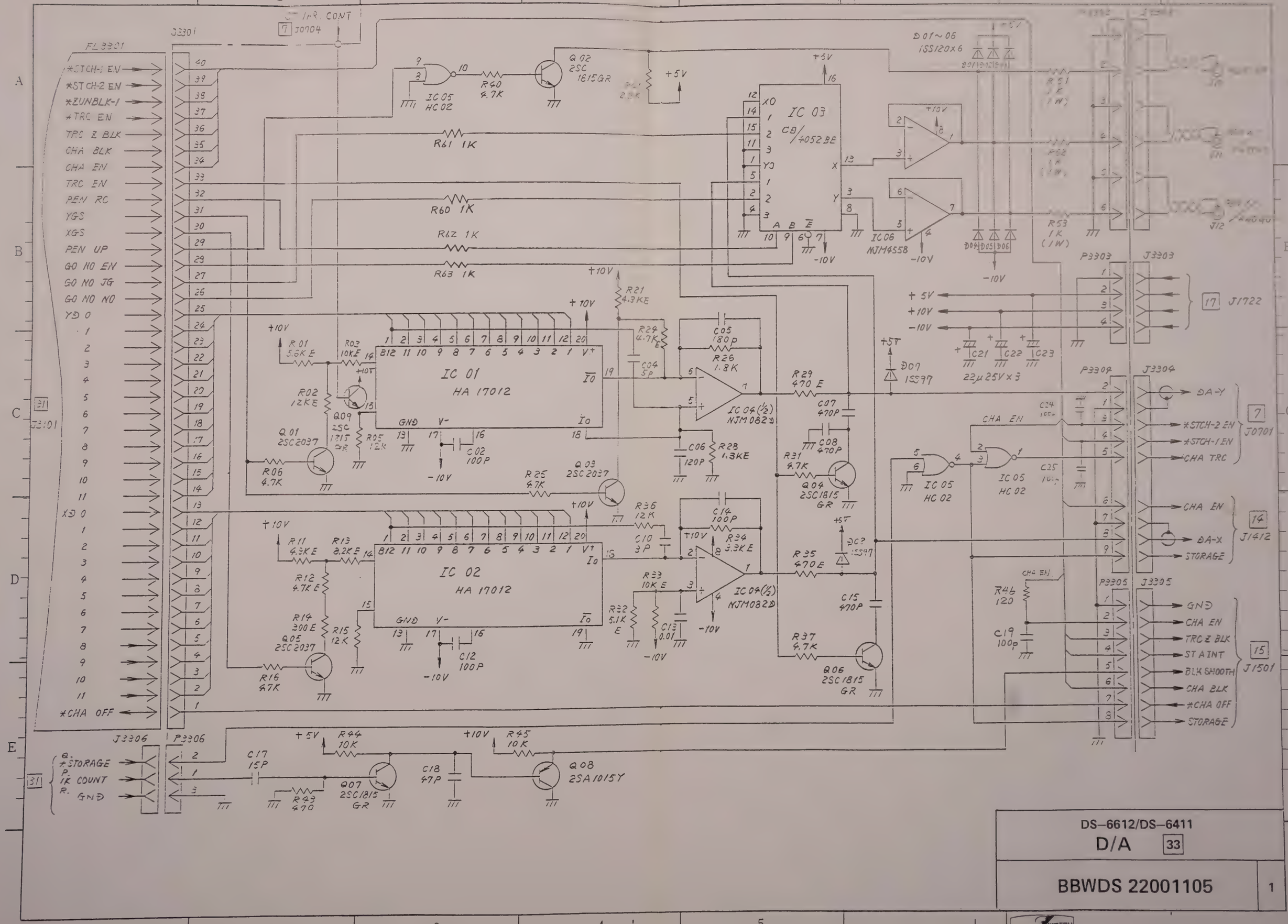
FL3101

IMCK (1-1G)
IKCK (1-1H)
+5V (D)
C3 0.01U. 50V
IC5J MB8464A
CA0 CA1 CA2 CA3 CA4 CA5 CA6 CA7 CA8 CA9 CA10 CA11 CA12
IO1 IO2 IO3 IO4 IO5 IO6 IO7 IO8
CMD0 CMD1 CMD2 CMD3 CMD4 CMD5 CMD6 CMD7
WE OE CS1 CS2 VCC GND
+5V (D)
IC4N MB81138
TBST NMWR NMOE CMD7 CMD6 CMD5 CMD4 CMD3 CMD2 CMD1 CMD0 CA12 CA11 CA10 CA9 CA8 CA7 CA6 CA5 CA4 CA3 CA2 CA1 CA0 NRES NWR NRD DBT DB6 DB5 DB4 DB3 DB2 DB1 DB0 AB3 AB2 AB1 AB0 NCS NBRQ CLK VSS2 VSS1 VDD2 VDD1 CKO2 CKO1 YGS XD11 XD10 XD9 XD8 XD7 XD6 XD5 XD4 XD3 XD2 XD1 XD0 NFF NFFR ZBLK NBAK DRQ2 DRQ1
YD0 YD1 YD2 YD3 YD4 YD5 YD6 YD7 YD8 YD9 YD10 YD11
XD0 XD1 XD2 XD3 XD4 XD5 XD6 XD7 XD8 XD9 XD10 XD11
SCR1EN (1-TH)
SCR2EN (1-TH)
TRCIBLK (1-1E)
SCR1EN (P3101-40)
SCR2EN (P3101-39)
TRCIBLK (P3101-26)
YD0 (P3101-25)
YD1 (P3101-24)
YD2 (P3101-23)
YD3 (P3101-22)
YD4 (P3101-21)
YD5 (P3101-20)
YD6 (P3101-19)
YD7 (P3101-18)
YD8 (P3101-17)
YD9 (P3101-16)
YD10 (P3101-15)
YD11 (P3101-14)
XD0 (P3101-13)
XD1 (P3101-12)
XD2 (P3101-11)
XD3 (P3101-10)
XD4 (P3101-9)
XD5 (P3101-8)
XD6 (P3101-7)
XD7 (P3101-6)
XD8 (P3101-5)
XD9 (P3101-4)
XD10 (P3101-3)
XD11 (P3101-2)
YGS (P3101-35)
XGS (P3101-36)
TRCEN (P3101-28)
PENEC (P3101-29)
XCHAOFF (P3101-1)
CHARABLK (P3101-25)
CHARABN (P3101-34)
PBNUP (P3101-30)
GONOEN (P3101-28)
GONOJG (P3101-27)
GONONO (P3101-26)
BZUNBLK1 (P3101-38)
BTRCEN (P3101-37)
33 J3101
IRST (1-2B)
CPU D
DB0 (1-1B) DB1 (1-1B) DB2 (1-1B) DB3 (1-1B) DB4 (1-1B) DB5 (1-1B) DB6 (1-1B) DBT (1-1B)
R1 2.7K
DIS120
C5 330P
IC2C-1 HC32
CPU A
AB0 (1-1C) AB1 (1-1C) AB2 (1-1C) AB3 (1-1C)
HCDP (1-1D)
HTRCREQ (1-7A)
IC4H MB81138
+5V (D)
C1 0.01U. 50V
X1 16.8MHZ
VCC GND
NFFR (1-6H)
HTRCEN (1-6H)
CHASTART (1-5H)
TRCEN (1-2E)
PBNRC (1-1D)
HBLKMEM (1-1D)
1KC ADDR
A0 (1-1F) A1 (1-1F) A2 (1-1F) A3 (1-1F) A4 (1-1F) A5 (1-1F) A6 (1-1F) A7 (1-1F) A8 (1-1F) A9 (1-1F) A10 (1-1F) A11 (1-1F)
IC2C-3 HC32
IC2C-4 HC32
IC2C-2 HC32
IC1B-2 HC08
IC1B-1 HC08
IC3E 6147 DIN
DB0 A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 DOUT WR CS
IC3H 8253
DB0 DB1 DB2 DB3 DB4 DB5 DB6 DBT AB0 AB1 RD WR CS D0 D1 D2 D3 D4 D5 D6 D7 A0 A1 CK0 GATE0 OUT0 CK1 GATE1 OUT1 CK2 GATE2 OUT2
(D) +5V
IC1G-3 HC04
IC2G-1 HC32
IC2G-3 HC32
TRCSHBLK (1-4A)
BSTSB (1-1D)
GATE2 (1-7G)
1KCOUNT (1-5A)
BSTORAGE (1-1G)
GND #3
*STORAGE #2
1K COUNT #1
33 J3306

DS-6612/DS-6411
CHA-B 31
GBWDS 10009105 2



DS-6612/DS-6411
CHA-C 32
GBWDS 11010105
3



DS–6612/DS–6411

D/A 33

BBWDS 22001105 | 1

CH-1 OUT (A/D)

CH-2 OUT (A/D)

SAWTOOTH

GATE OUT

EXT CLOCK

EQU CLK

INT CLK

*EQU

*EXT

*WRITE START ENABLE

CH-2 DATA

T101, 201 --- KS T8-10-2.5

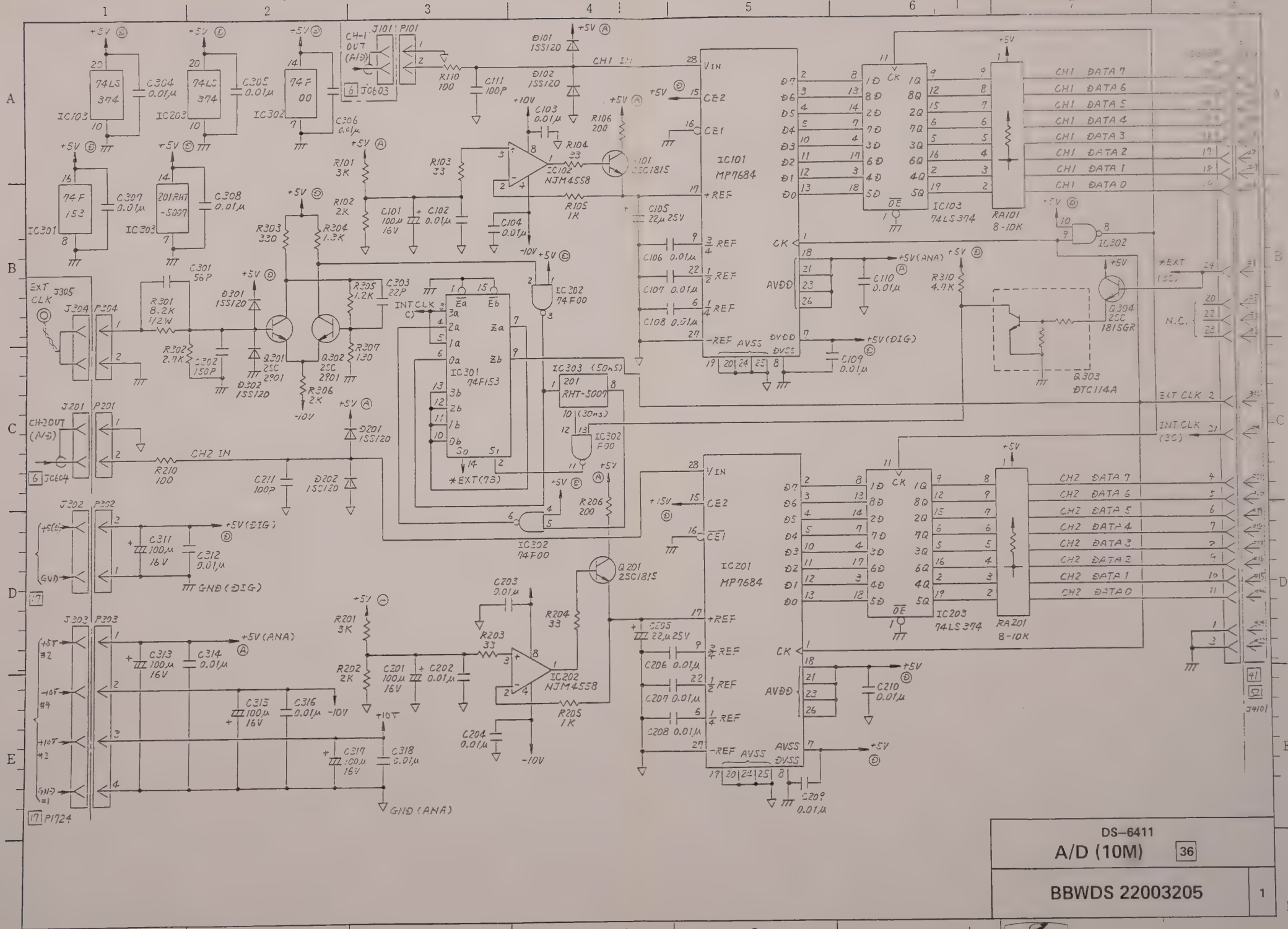
T102, 202 --- KS T3-6-1.5

201RHT0000 series
(TOP VIEW)

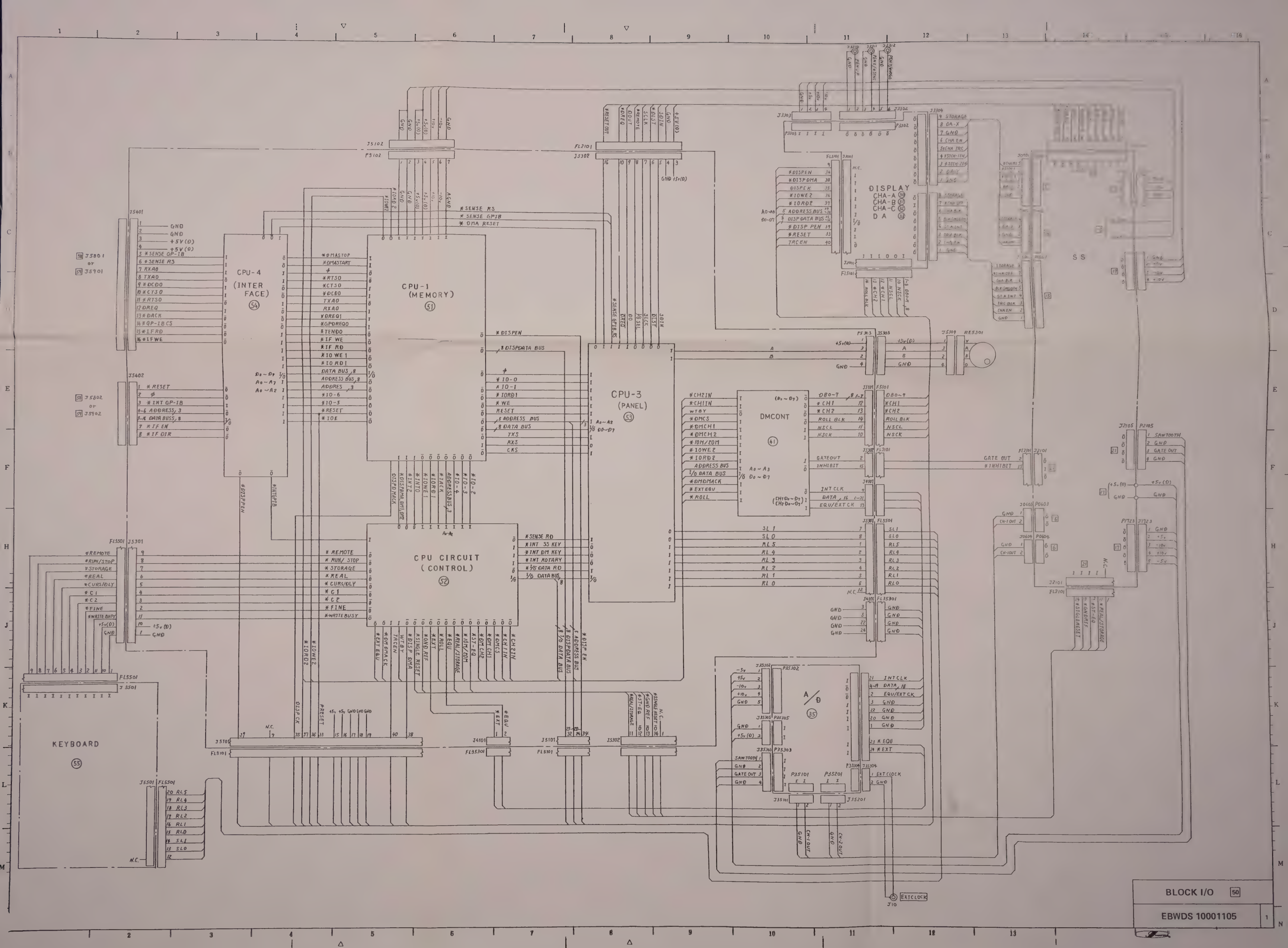
Tap1 Tap3 DUT
Tap2 Tap4 GND

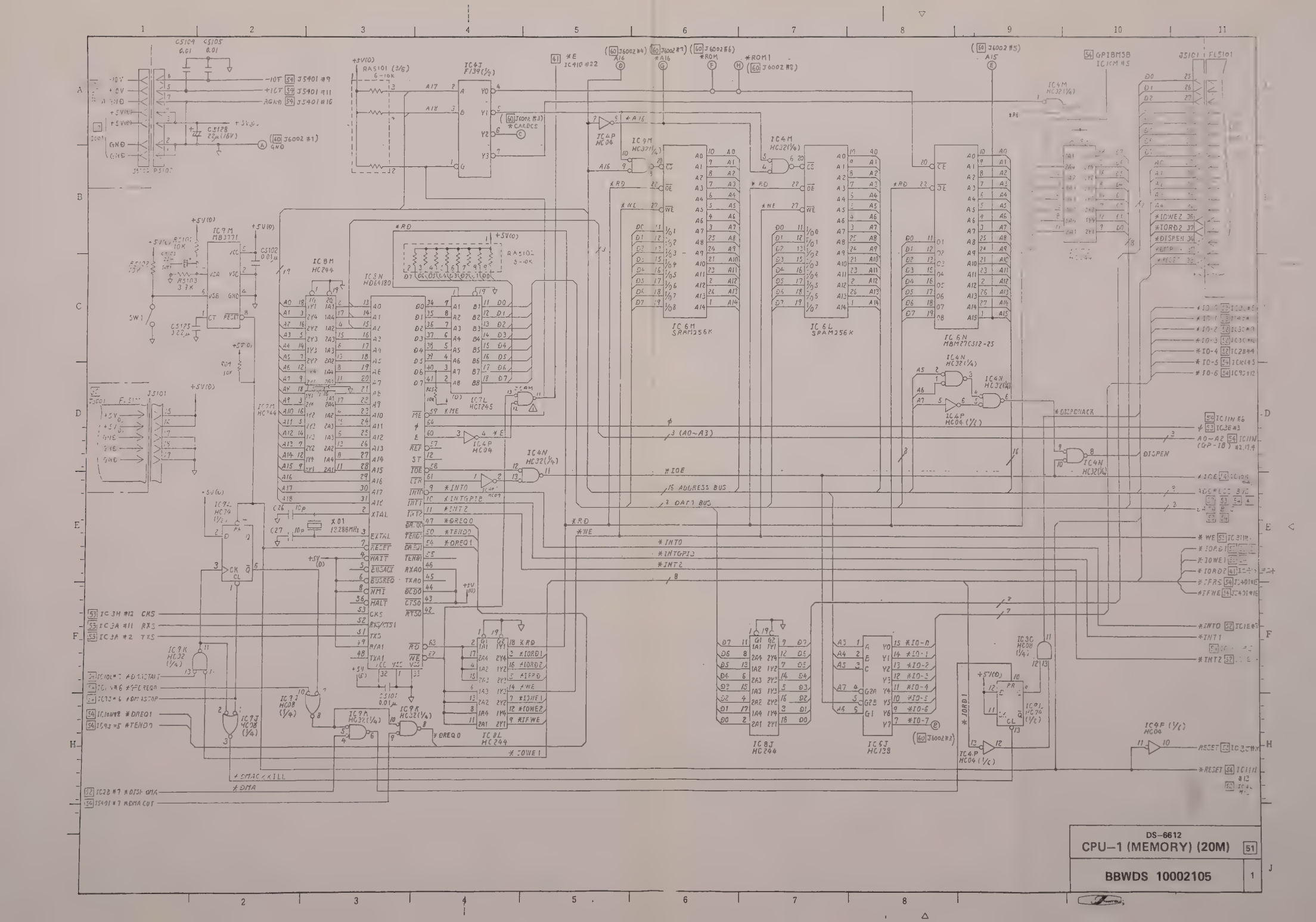
AT-02
Delay Line

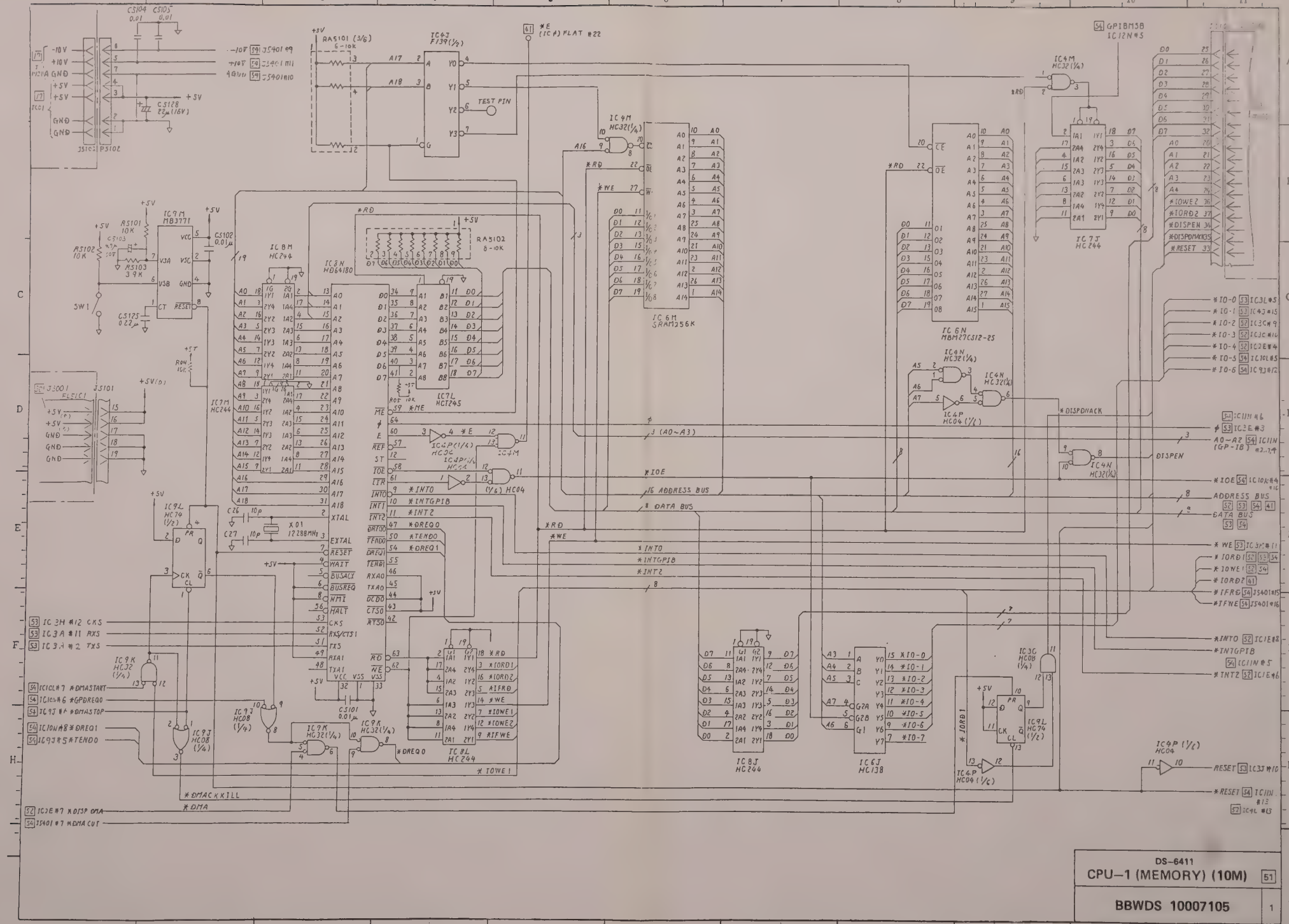
DS-6612
A/D (20M) 35
EBWDS 22002105 1

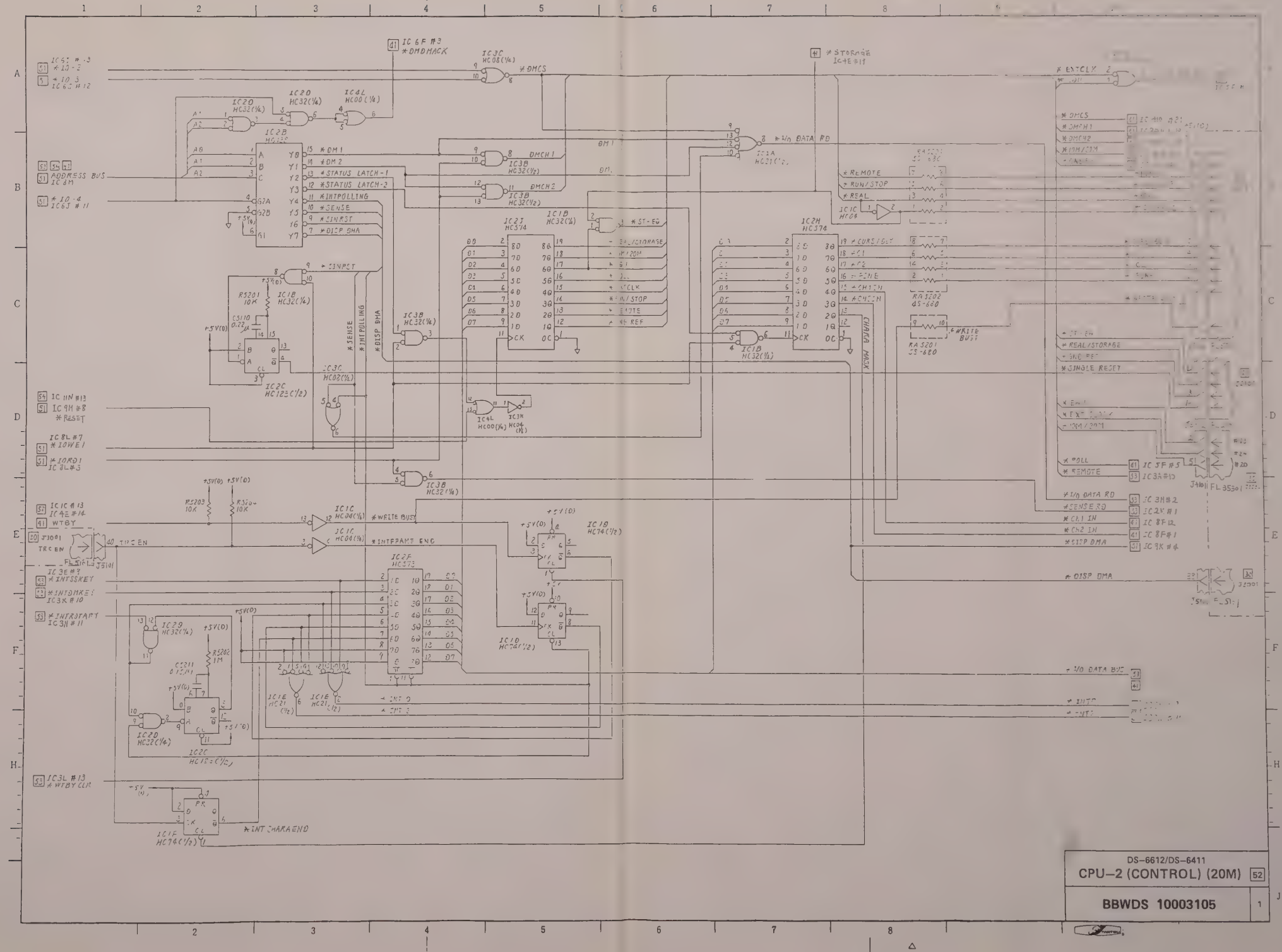

CH1 IN
CH2 IN
CH1 DATA 7
CH1 DATA 6
CH1 DATA 5
CH1 DATA 4
CH1 DATA 3
CH1 DATA 2
CH1 DATA 1
CH1 DATA 0
CH2 DATA 7
CH2 DATA 6
CH2 DATA 5
CH2 DATA 4
CH2 DATA 3
CH2 DATA 2
CH2 DATA 1
CH2 DATA 0
EXT CLK
INT CLK
*EXT (75)
IC101 MP7684
IC201 MP7684
IC103 74LS374
IC203 74LS374
IC301 74F153
IC303 (50nS)
IC102 NJM4558
IC202 NJM4558
IC302 74F00
RA101 8-10K
RA201 8-10K
Q303 DTC114A
Q304 2SC 1815GR
GND (DIG)
GND (ANA)
+5V (ANA)
+5V (DIG)
DS-6411
A/D (10M) 36
BBWDS 22003205 1

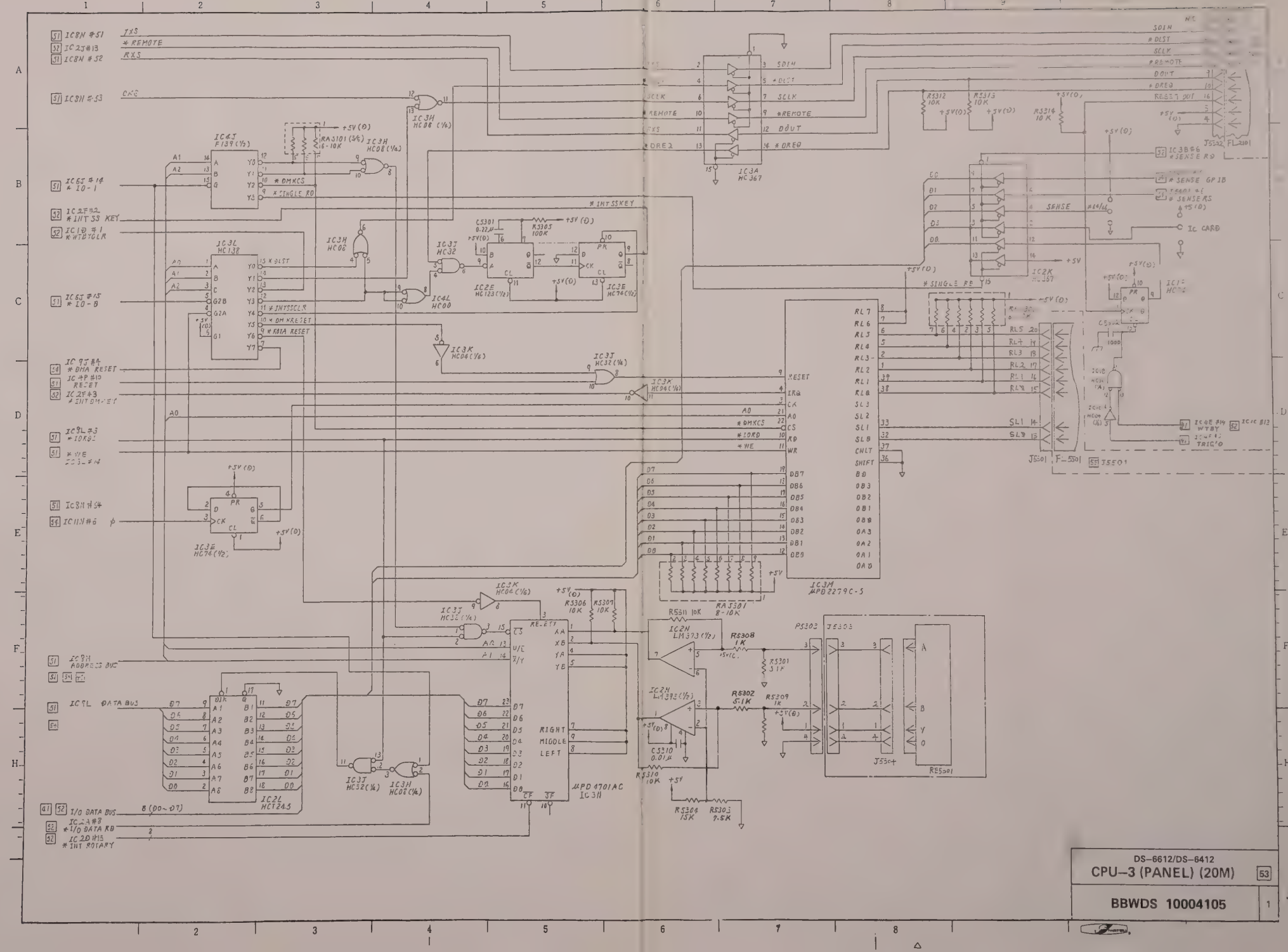
*CH1 IN
*CH2 IN
*ROLL
*GND REF
*DM DMACK
*EXT EQU
*DM CH2
*DM CH1
*CH2 ROLL
*CH1 ROLL
I/O DATA BUS 0~7
READ CK/2
READ CK
20M EXT
*R/W
*10/20
*INT/EXT
*STORAGE
IC410 MB670102
IC11F CK2605
IC4H RHT5009P (10~30n)
IC1A RHT5009P
IC3F RHT5009P (30n)
IC1K RHT5009P (20n)
IC9B F396
IC9C F396
IC11B HM6788-25
IC11C HM6788-25
IC11D HM6788-25
IC11E HM6788-25
IC9E F396
IC8B LS244
IC8C LS244
IC8D LS244
IC9D LS244
IC9H F74
IC6F F74
IC5D F74
IC5J F74
IC6H F74
FL3S301
FL3S101
FL2101
FL3101
J3001
J5101
J2101
J3101
J4101
J5
J3
[Note]
within [ ] is a same IC
DS-6612/DS-6411
DM CONT 41
EBWDS 12001105 1


CPU-4
(INTER FACE)
54
CPU-1
(MEMORY)
51
CPU-3
(PANEL)
53
CPU CIRCUIT
(CONTROL)
52
DMCONT
41
A/D
35
DISPLAY
CHA-A
CHA-B
CHA-C
D A
KEYBOARD
55
BLOCK I/O 50
EBWDS 10001105 1

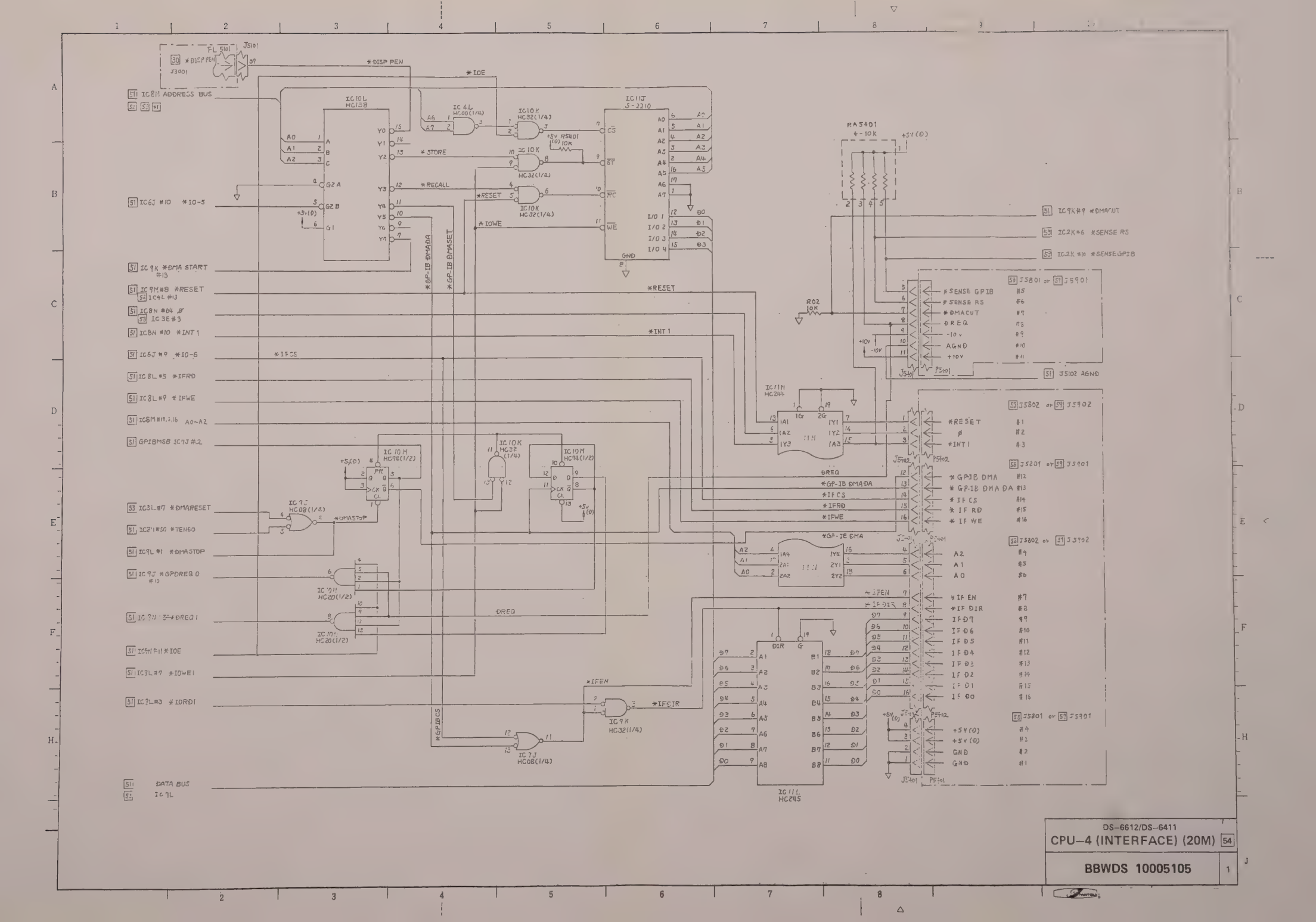

DS-6612
CPU-1 (MEMORY) (20M)
51
BBWDS 10002105
1

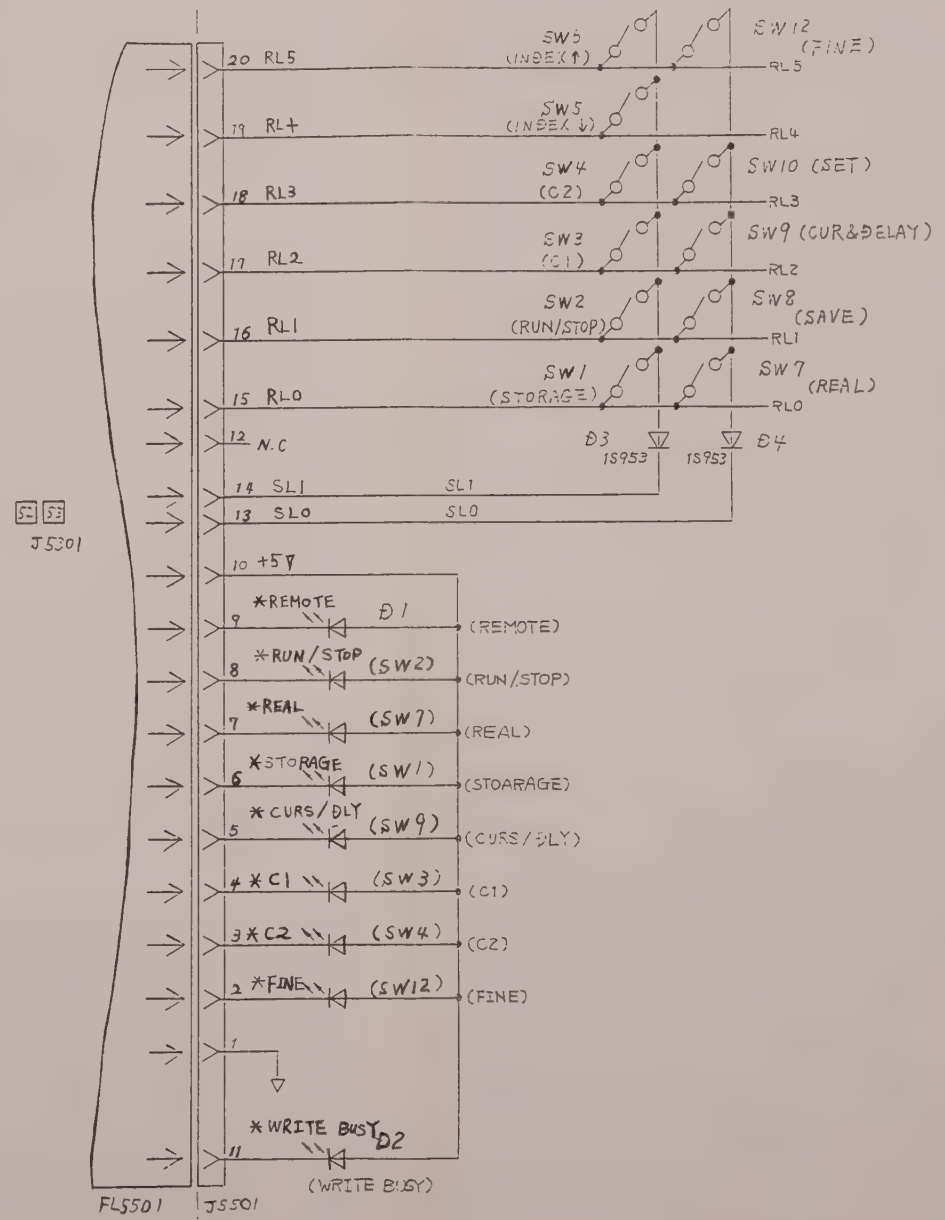

DS-6411
CPU–1 (MEMORY) (10M)
51
BBWDS 10007105
1


IC 6F #3
*DMDMACK
IC3C HC08(¼)
≠DMCS
IC2D HC32(¼)
IC4L HC00(¼)
IC2B HC138
ADDRESS BUS IC 4M
*IO-4 IC6J #11
*DM1
*DM2
*STATUS LATCH-1
*STATUS LATCH-2
*INTPOLLING
*SENSE
*CINRST
*DISP DMA
DMCH1
DMCH2
IC3B HC32(½)
IC1A HC21(½)
*I/O DATA RD
IC1B HC32(¼)
IC2J HC374
IC2H HC374
*REMOTE
*RUN/STOP
*REAL
IC1C HC04
RA 3201 4S-680
*WRITE BUSY
CHANA MASK
*CURS/CLK
*EXTCLK
*DMCS
*DMCH1
*DMCH2
*RUN/STOP
*REAL/STORAGE
*SINGLE RESET
*POLL
*REMOTE
IC 3F #5
IC 3A #13
J3401
FL 3530
IC 3H #2
IC 2K #1
IC 8F 12
IC 8F #1
IC 9K #4
*DISP DMA
IC 1N #13
IC 9M #8
*RESET
IC 8L #7
*IOWE1
*IORD1
IC 8L #3
IC4E #14
WTBY
J3001
TRC EN
FL 3101
J3101
IC3E #3
*INTSSKEY
IC3K #10
*INTDMKEY
*INTRSTART
IC3H #11
IC2F HC573
IC1B HC74(½)
IC1D HC74(½)
IC2G HC32(¼)
IC2C HC123(½)
IC1E HC21(½)
*INT 0
*INT 3
*I/O DATA BUS
*INTC
*INTS
IC3L #13
*WTBY CLR
IC1F HC74(½)
*INT CHARAEND
*INTFRAME END
IC3B HC32(¼)
IC2C HC123(½)
IC3C HC02(¼)
IC4L HC00(¼)
IC3K HC04(¼)
IC1B HC32(¼)
IC2B HC138
IC2D HC32(¼)
IC4L HC00(¼)
IC1C HC04(¼)
IC1C HC08(¼)
IC2G HC32(¼)
IC2C HC123(½)
IC1F HC74(½)
IC2F HC573
IC1B HC74(½)
IC1D HC74(½)
IC1E HC21(½)
IC1E HC21(½)
IC2J HC374
IC2H HC374
IC1B HC32(¼)
IC1A HC21(½)
IC1C HC04
IC3B HC32(¼)
IC3B HC32(½)
IC3B HC32(½)
IC3C HC02(¼)
IC4L HC00(¼)
IC3K HC04(¼)
IC1C HC04(¼)
IC1C HC08(¼)
IC2G HC32(¼)
IC2C HC123(½)
IC1F HC74(½)
IC2F HC573
IC1B HC74(½)
IC1D HC74(½)
IC1E HC21(½)
IC1E HC21(½)
IC2J HC374
IC2H HC374
IC1B HC32(¼)
IC1A HC21(½)
IC1C HC04
IC3B HC32(½)
IC3B HC32(½)
DS-6612/DS-6411
CPU–2 (CONTROL) (20M)
52
BBWDS 10003105
1

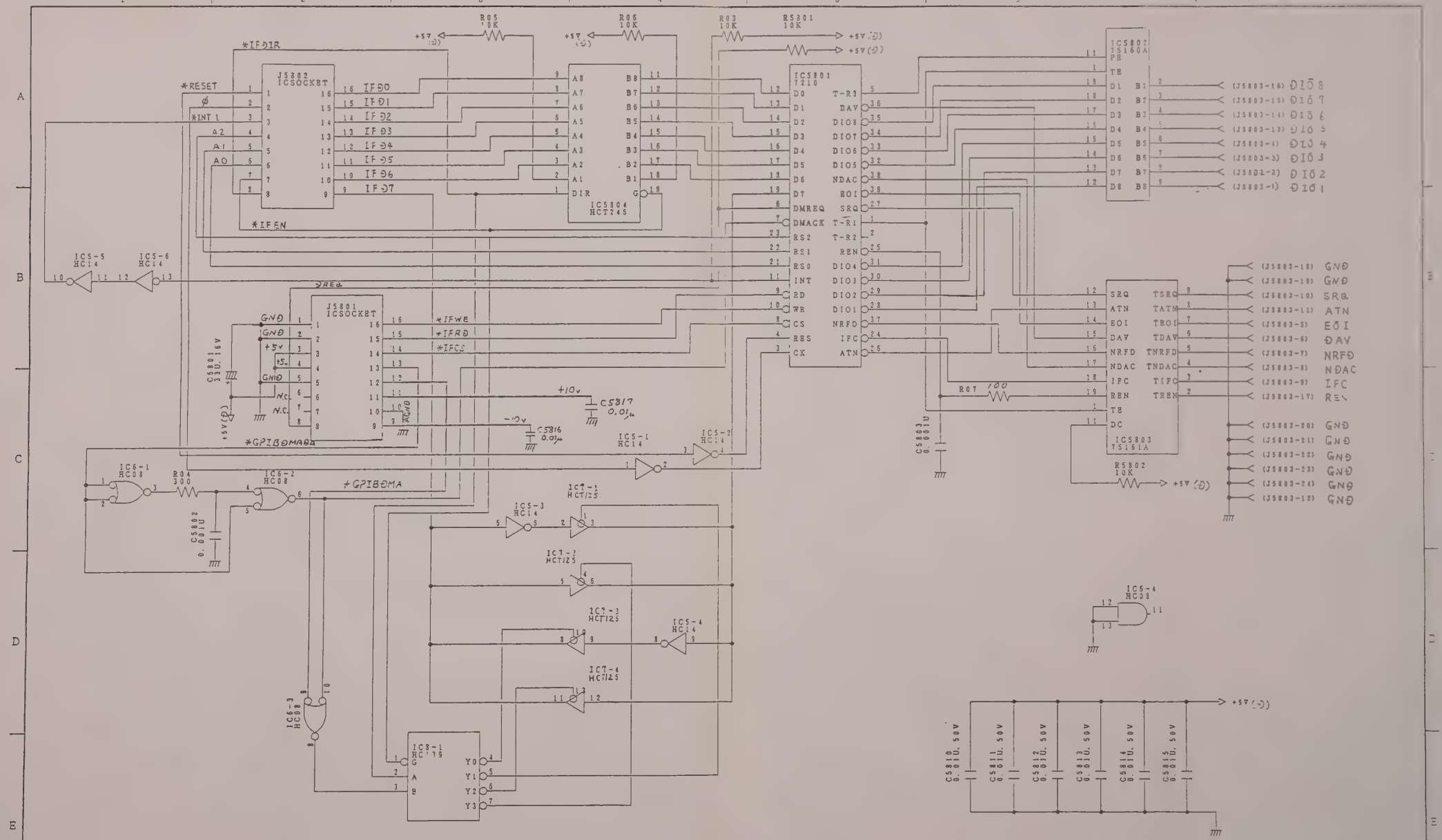


DS-6612/DS-6412
CPU-3 (PANEL) (20M) 53
BBWDS 10004105 1


DS-6612/DS-6411
CPU-4 (INTERFACE) (20M) 54
BBWDS 10005105 1



KEY BOARD	55
BBWDS 40003105	1



DS–504	
GP–IB	58
BBWDS 13001105	1

Section 6 Electrical Parts List

Ordering Information

Replacement parts may be ordered through an IWATSU representative or directly from the factory. To be cartain of receiving the proper parts, a ways include the following information with the order:

a. Model Number and serial number of the instrument on which the parts will be installed.
b. Circuit reference number and subassembly name, if applicable, for which the part is intended. If the part does not have a circuit reference, the description from the parts list should be used.
c. Iwatsu part number.

For factory repair, contact the IWATSU agent and include the following information:

a. Model number and serial number of the instrument on which the work is to be performed.
b. Details concerning the nature of the malfunction, or type of repair desired.

Shipping instructions will be sent to you promptly.

Component locations can be determined from the schematic diagrams, each component appears only once in the parts list. At the beginning of each subsection are listed part number for any complete subassemblies in that category that are available replacement parts. These subassemblies may include individually-listed components; care should be taken to pinpoint malfunctions to the exact replacement parts actually needed and thus avoid the time and cost involved in "over-repair".

Abbreviations

Cap . . . . . .Capacitor
Cer . . . . . .Ceramic
Poly . . . . . .Polyethytel film
Elect. . . . . .Aluminum electrolytic chemical
Elect. tan. . . . . .Tan-talum electrolytic chemical condenser
[The symbol F (farad) is omitted]
Res. . . . . .Resistor
W.W . . . . . .Wire wound
Comp . . . . . .Composition
[The symbol Ω (ohm) is omitted]
FET . . . . . .Field Effect Transistor
Diode . . . . . .
T. diode. . . . . .Tunnel diode
Z. diode. . . . . .Zenner diode
S.B. diode . . . . . .Schottky barrier diode
V.C. diode . . . . . .Variable capacitance diode
L.E.D.. . . . . .Light emission diode
IC. . . . . .Integrated Circuit
Var. . . . . .Variable

ATT 2

DS-6612

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C0201	Cap., 0.047μ, ±20%, 400V, Film	DCF168011
C0203	Same as C0201	
C0211	Cap., (20.5 ~ 3.3)p, Var., 250V, Cer.	DCV019592
C0212	Cap., (2 ~ 12)p, Var., 250V, Cer.	DCV019602
C0213	Cap., 8p, ±0.5p, 500V, Cer.	DCC259181
C0214	Same as C0211	
C0215	Cap., (2 ~ 8)p, Var., 250V, Cer.	DCV019612
C0216	Same as C0211	
C0217	Same as C0212	
C0218	Cap., 4p, ±0.25p, 500V, Cer.	DCC259121
C0219	Cap., 47p, ±5%, 50V, Cer.	DCC249511
C0220	Same as C0211	
C0221	Same as C0215	
C0222	Cap., 470p, ±5%, 50V, Cer.	DCC237481
C0223	Cap., 6p, ±0.5p, 500V, Cer.	DCC251001
C0225	Same as C0211	
C0226	Same as C0215	
C0227	Cap., 2700p, ±5%, 50V, Cer.	DCC237491
C0229	Cap., 3p, ±0.25p, 500V, Cer.	DCC259151
C0231	Cap., 6p, ±0.5p, 50V, Cer.	DCC239091
C0241	Same as C0211	
C0242	Same as C0212	
C0243	Same as C0213	
C0244	Same as C0211	
C0245	Same as C0215	
C0246	Same as C0211	
C0247	Same as C0212	
C0248	Same as C0223	
C0249	Cap., 68p, ±5%, 50V, Cer.	DCC246551
C0250	Same as C0211	
C0251	Same as C0215	
C0252	Same as C0222	
C0253	Same as C0223	
C0255	Same as C0211	
C0256	Same as C0215	
C0257	Same as C0227	
C0258	Same as C0215	
C0259	Same as C0229	
C0260	Cap., 22p, ±5%, 50V, Cer.	DCC239121

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0201	Res., 10, ±5%, 1/4W, Carbon	DRD134351
R0202	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R0203	Same as R0202	
R0205, R0206	Same as R0202	
R0212	Res., 500K, ±0.5%, 1/4W, Metal	DRE938071
R0213	Res., 1.0M, ±0.5%, 1/4W, Metal	DRE938371
R0214	Res., 750K, ±0.5%, 1/4W, Metal	DRE938361
R0215	Res., 333K, ±0.5%, 1/4W, Metal	DRE938061
R0216	Res., 900K, ±0.5%, 1/4W, Metal	DRE938081
R0217	Res., 111K, ±0.5%, 1/4W, Metal	DRE938341
R0218	Res., 180, ±5%, 1/4W, Carbon	DRD137436
R0219	Res., 91, ±5%, 1/4W, Carbon	DRD137391
R0220	Res., 8.2, ±5%, 1/4W, Carbon	DRD137141
R0221	Res., 990K, ±0.5%, 1/4W, Metal	DRE938091
R0222	Res., 10.1K, ±0.5%, 1/4W, Metal	DRE938311
R0223	Res., 510, ±5%, 1/4W, Carbon	DRD137571
R0224	Res., 20, ±5%, 1/4W, Carbon	DRD137231
R0225	Res., 1.1K, ±5%, 1/4W, Carbon	DRD137651
R0226	Res., 999K, ±0.5%, 1/4W, Metal	DRE931101
R0227	Res., 1.001K, ±0.5%, 1/4W, Metal	DRE938011
R0228	Res., 820, ±5%, 1/4W, Carbon	DRD137621
R0231	Same as R0201	
R0232, R0233	Same as R0202	
R0235, R0236	Same as R0202	
R0242	Same as R0212	
R0243	Same as R0213	
R0244	Same as R0214	
R0245	Same as R0215	
R0246	Same as R0216	
R0247	Same as R0217	
R0248	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R0249	Res., 75, ±5%, 1/4W, Carbon	DRD137391
R0250	Res., ±5%, 1/4W, Carbon	DRD137181
R0251	Same as R0221	
R0252	Same as R0222	
R0253	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0254	Res., 20, ±5%, 1/4W, Carbon	DRD137271
R0255	Res., 300, ±5%, 1/4W, Carbon	DRD137511
R0256	Res., 999K, ±0.5%, 1/4W, Metal	DRE938101
R0257	Same as R0227	
R2058	Res., 750, ±5%, 1/4W, Carbon	DRD137611

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
S0201	Switch, SUJ12A	DSW014831
S0202	Same as S0201	
S0203	Switch, PS22BH5-6-11/1KB	DSW033002
S0204, S0205	Same as S0201	
S0206	Same as S0203	
P0211	Connector, M36-05-30-134P	DCN034931
P0212	Same as P0211	
J0211	Connector, M36M87-05	DCN034631
J0212	Same as J0211	
TB0201	8ϕ ground terminal B	DTA020501

DS-6411

C0201	Cap., 0.047μ, ±20%, 400V, Film	DCF168011
C0203	Same as C0201	
C0211	Cap., (20.5 ~ 3.3)p, Var., 250V, Cer	DCV019592
C0212	Cap., (2 ~ 12)p, Var., 250V, Cer.	DCV019602
C0213	Cap., 8p, ±0.5p, 500V, Cer.	DCC259181
C0214	Same as C0211	
C0215	Cap., (2 ~ 8)p, Var., 250V, Cer.	DCV019612
C0216	Same as C0211	
C0217	Same as 2C12	
C0218	Cap., 4p, ±0.25p, 500V, Cer.	DCC259121
C0219	Cap., 47p, ±5%, 50V, Cer.	DCC249511
C0220	Same as C0211	
C0221	Same as C0215	
C0222	Cap., 470p, ±5%, 50V, Cer.	DCC237481
C0223	Cap., 6p, ±0.5p, 500V, Cer.	DCC251001
C0225	Same as C0211	
C0226	Same as C0215	
C0227	Cap., 2700p, ±5%, 50V, Cer.	DCC237491
C0229	Cap., 3p, ±0.25p, 500V, Cer.	DCC259151
C0241	Same as C0211	
C0242	Same as C0212	
C0243	Same as C0213	
C0244	Same as C0211	
C0245	Same as C0215	
C0246	Same as C0211	
C0247	Same as C0212	
C0248	Same as C0223	
C0249	Cap., 68p, ±5%, 50V, Cer.	DCC246551
C0250	Same as C0211	
C0251	Same as C0215	
C0252	Same as C0222	
C0253	Same as C0223	
C0255	Same as C0211	
C0256	Same as C0215	
C0257	Same as C0227	
C0258	Same as C0215	
C0259	Same as C0229	
C0260	Cap., 22p, ±5%, −50V, Cer.	DCC239121
R0201	Res., 10, ±5%, 1/4W, Carbon	DRD134351
R0202	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R0203	Same as R0202	
R0205, R0206	Same as R0202	
R0212	Res., 500K, ±0.5%, 1/4W, Metal	DRE938071
R0213	Res., 1.0M, ±0.5%, 1/4W, Metal	DRE938371
R0214	Res., 750K, ±0.5%, 1/4W, Metal	DRE938361
R0215	Res., 333K, ±0.5%, 1/4W, Metal	DRE938061
R0216	Res., 900K, ±0.5%, 1/4W, Metal	DRE938081
R0217	Res., 111K, ±0.5%, 1/4W, Metal	DRE938041
R0218	Res., 200, ±5%, 1/4W, Carbon	DRD137471
R0219	Res., 91, ±5%, 1/4W, Carbon	DRD137391
R0220	Res., 8.2, ±5%, 1/4W, Carbon	DRD137141
R0221	Res., 990K, ±0.5%, 1/4W, Metal	DRE938091
R0222	Res., 10.1K, ±0.5%, 1/4W, Metal	DRE938311
R0223	Res., 620, ±5%, 1/4W, Carbon	DRD137591
R0224	Res., 22, ±5%, 1/4W, Carbon	DRD137241
R0225	Res., 1.1K, ±5%, 1/4W, Carbon	DRD137651
R0226	Res., 999K, ±0.5%, 1/4W, Metal	DRE931101
R0227	Res., 1.001K, ±0.5%, 1/4W, Metal	DRE938011
R0228	Res., 620, ±5%, 1/4W, Carbon	DRD137591
R0231	Same as R0201	
R0232	Same as R0202	
R0233	Same as R0202	
R0235, R0236	Same as R0202	
R0242	Same as R0212	
R0243	Same as R0213	
R0244	Same as R0214	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0245	Same as R0215	
R2046	Same as R0216	
R0247	Same as R0217	
R0248	Res., 240, ±5%, 1/4W, Carbon	DRD137491
R0249	Res., 75, ±5%, 1/4W, Carbon	DRD137391
R0250	Res., 12, ±5%, 1/4W, Carbon	DRD137181
R0251	Same as R0221	
R0252	Same as R0222	
R0253	Res., 360, ±5%, 1/4W, Carbon	DRD137531
R0254	Res., 16, ±5%, 1/4W, Carbon	DRD137211
R0255	Res., 430, ±5%, 1/4W, Carbon	DRD137551
R0256	Res., 999K, ±0.5%, 1/4W, Metal	DRE938101
R0257	Same as R0227	
R0258	Res., 750, ±5%, 1/4W, Carbon	DRD137611
S0201	Switch, SUJ12A	DSW014831
S0202	Same as S0201	
S0203	Switch, PS22BH5-6-11/1KB	DSW033002
S0204, S0205	Same as S0201	
S0206	Same as S0203	
P0211	Connector, M36-05-30-134P	DCN034931
P0212	Same as P0211	
J0211	Connector, M36M87-05	DCN034631
J0212	Same as J0211	
TB0201	8ϕ ground terminal B	DTA020501

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612		
C0301	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0302	Cap., (5.5 ~ 1.5)p, Var., 250V, Cer.	DCV019722
C0303	Cap., 1000p, ±10%, 500V, Cer.	DCC159011
C0304	Cap., 120p, ±5%, 50V, Cer.	DCC239261
C0305	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C0306	Same as C0301	
C0307	Same as C0305	
C0308	Same as C0301	
C0309	Same as C0305	
C0310 to C0212	Same as C0301	
C0313	Cap., (2 ~ 12)p, Var., 250V, Cer.	DCV019602
C0314	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C0315	Same as C0314	
C0317	Cap., 27p, ±5%, 50V, Cer.	DCC239241
C0318	Same as C0305	
C0319	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0322	Same as C0305	
C0323	Cap., 0.022μ, ±10%, 50V, Film	DCF121361
C0324	Same as C0305	
C0325	Cap., 8p, ±0.5p, 50V, Cer.	DCC239211
C0327	Same as C0301	
C0328	Cap., 2p, ±0.25p, 50V, Cer.	DCC239061
C0329	Same as C0328	
C0330 to C0332	Same as C0301	
C0335	Same as C0305	
C0336	Cap., 180p, ±5%, 50V, Cer.	DCC239271
C0337, C0338	Same as C0319	
C0339, C0340	Same as C0301	
C0342, C0343	Same as C0301	
C0344	Same as C0305	
C0345, C0346	Same as C0301	
C0348	Same as C0301	
R0301	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R0302	Res., 1K, Var., 0.2W, Carbon	DRV145891
R0303	Res., 470K, ±5%, 1/2W, Carbon	DRD138281
R0304	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0307	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0308	Res., 47, ±5%, 1/4W, Carbon	DRD137321

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0309	Same as R0307	
R0320	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0321	Res., 20K, Var., 0.3W, Metal glazed	DRV412161
R0322	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0323	Res., 100, ±1%, 1/4W, Metal	DRE137641
R0324	Same as R0320	
R0325	Same as R0307	
R0326	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R0327	Same as R0326	
R0328, R0329	Same as R0320	
R0330	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0331	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
R0332	Same as R0331	
R0333	Same as R0330	
R0334	Res., 270, ±1%, 1/4W, Metal	DRE137741
R0337	Res., 100, Var., 1/2W, Cermet	DRV410501
R0338	Same as R0334	
R0339	TH., 112101-2	DDD080331
R0340	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0341	Same as R0340	
R0342	Res., 68K, ±5%, 1/4W, Carbon	DRD138081
R0345	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0346	Same as R0345	
R0347, R0348	Same as R0307	
R0349	Res., 27, ±5%, 1/4W, Carbon	DRD137261
R0350	Res., 1K, Var., 0.2W, Carbon	DRV145891
R0351	Same as R0349	
R0352	Same as R0337	
R0353	Res., 22, ±1%, 1/4W, Metal	DRE137481
R0354	Res., 56, ±1%, 1/4W, Metal	DRE137581
R0355, R0356	Same as R0307	
R0357	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R0358	Same as R0357	
R0360	Res., 27K, ±5%, 1/4W, Carbon	DRD137981
R0361	Res., 910, ±1%, 1/4W, Metal	DRE137871
R0362	Same as R0361	
R0363	Res., 150, ±1%, 1/4W, Metal	DRE137681
R0364	Res., 200, Var., 1/2W, Metal	DRV415511
R0365	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R0366	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R0367	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R0368	TH., 112101-2	DDD080421
R0369	Same as R0367	
R0370	Same as R0354	
R0371	Same as R0354	
R0372, R0373	Same as R0307	
R0374	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0375	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R0376	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R0377, R0378	Same as R0334	
R0379	Res., 6.8K, ±1%, 1/4W, Metal	DRE138081
R0380	Same as R0379	
R0381 to R0384	Same as R0320	
R0386	Same as R0304	
R0387	Res., 560, ±1%, 1/4W, Metal	DRE137821
R0388	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R0389	Same as R0320	
R0390	Res., 12K, ±1%, 1/4W, Metal	DRE138141
R0391	Same as R0390	
R0392	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R0394	Res., 430, ±1%, 1/4W, Metal	DRE137791
R0395	Same as R0392	
R0396	Res., 47, ±1%, 1/4W, Metal	DRE137561
R0397	Res., 680, ±1%, 1/4W, Metal	DRE137841
R0398	Same as R0397	
R03100, R03101	Same as R0320	
R03102, R03103	Same as R0326	
R03104, R03105	Same as R0334	
R03106	Res., 470, ±1%, 1/4W, Metal	DRE137801
R03107, R03108	Same as R0397	
R03109	Same as R0396	
R03110	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R03111	Same as R0397	
R03112	Same as R03110	
R03113	Same as R0397	
R03114	Res., 10K, Var., 0.3W, Metal glazed	DRV412151
R03115	Res., 5.1K, ±1%, 1/4W, Metal	DRE138051
R03116	Res., 5.6K, ±1%, 1/4W, Metal	DRE138061
R03117	Same as R03116	
R03118	Res., 120, ±5%, 1/4W, Carbon	DRD137421
R03119	Same as R0320	
R03120	Res., 1.2K, ±1%, 1/4W, Metal	DRE137901
R03121	Same as R03120	
R03122	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R03123	Same as R0307	
R03124	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R03126	Res., 6.2K, ±5%, 1/4W, Carbon	DRD137831
R03127	Res., 2.0, ±5%, 1/4W, Carbon	DRD137711
R03128	Res., 50K, VAR., 0.3W, Metal glazed	DRV412111
R03129	Res., 15K, ±5%, 1/4W, Carbon	DRD137921
D0301	Diode, 1SS 120 TA21R	DDD019071
D0302	Diode, 1S 154 TA21R	DDD019801
D0303	Same as D0302	
D0304, D0305	Same as D0301	
D0310	Same as D0301	
D0311	Diode array, DAP201	DDD991081
D0312	Same as D0311	
D0313	Diode, RD6.8ESB/HZS68NB TA21R	DDD038731
Q0301	Transistor, μ-PA 61AL	DTR295361
Q0302	Transistor, 2SC 1907 TR	DTR139061
Q0303 to Q0305	Same as Q0302	
Q0306	Transistor, 2SA 1206 TRC	DTR119041
Q0307	Same as Q0306	
Q0308 to Q0314	Same as Q0302	
Q0315 to Q0318	Same as Q0306	
Q0319 to Q0322	Same as Q0302	
Q0325	Transistor, DTC 114-A	DTR190941
Q0327	Transistor, 2SA 1015Y TPER 1	DTR119011
Q0328	Same as Q0327	
Q0329	Same as Q0326	
Q0330, Q0331	Same as Q0302	
RL0301	Relay, G5Y-1004M	DKD026091
J0301	Connector, ZC-040	DCN032721
J0303	Connector, M31M87-07	DCN034501
J0304	Connector, M36M87-02	DCN034601
P0303	Connector, M33-07-30-114P	DCN034691
P0304	Connector, M36M87-02	DCN034601
FL03301	Flat cable SMCD40x80ADx10(2.7)-P1.25	KHB088811

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6411		
C0302	Cap., (1.5 ~ 5.5)p, Var., 250V, Cer.	DCV019722
C0303	Cap., 1000p, ±10%, 500V, Cer.	DCC159011
C0304	Cap., 120p, ±5%, 50V, Cer.	DCC239261
C0305	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C0306	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0307	Same as C0305	
C0308	Same as C0306	
C0309	Same as C0305	
C0310 to C0312	Same as C0306	
C0313	Cap., (2 ~ 12)p, Var., 250, Cer.	DCV019602
C0314	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C0315	Same as C0314	
C0317	Cap., 27p, ±5%, 50V, Cer.	DCC239241
C0318	Same as C0317	
C0319	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0322	Same as C0305	
C0323	Cap., 0.022μ, ±10%, 50V, Film	DCF121361
C0324	Same as C0305	
C0325	Cap., 8p, ±0.5p, 50V, Cer.	DCC239211
C0327	Same as C0306	
C0328	Cap., 2p, ±0.25p, 50V, Cer.	DCC239061
C0329	Same as C0328	
C0330 to C0332	Same as C0306	
C0335	Same as C0305	
C0336	Cap., 180p, ±5%, 50V, Cer.	DCC239271
C0337, C0338	Same as C0319	
C0339, C0340	Same as C0306	
C0342	Same as C0306	
C0343	Same as C0306	
C0344	Same as C0305	
C0345, C0346	Same as C0306	
C0348	Same as C0306	
C0350	Same as C0328	
R0302	Res., 1M, ±0.5%, 1/4W, Metal	DRE930221
R0303	Res., 470K, ±5%, 1/2W, Carbon	DRD148281
R0304	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0307	Res., 100, ±5%, 1/4W, Carbon	DRD137401

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0308	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0309	Same as R0309	
R0320	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0321	Res., 20K, Var., 0.3W, Metal glazed	DRV41261
R0322	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0323	Res., 100, ±1%, 1/4W, Metal	DRE137641
R0324	Same as R0320	
R0325	Same as R0307	
R0326	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R0327	Same as R0326	
R0328, R0329	Same as R0320	
R0330	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0331	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
R0332	Same as R0331	
R0333	Same as R0330	
R0334	Res., 270, ±1%, 1/4W, Metal	DRE137741
R0337	Res., 100, Var., 1/2W, Cermet	DRV410501
R0338	Same as R0334	
R0339	TH., 112101-2	DDD080331
R0340	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0341	Same as R0340	
R0342	Res., 68K, ±5%, 1/4W, Carbon	DRD138081
R0345	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0346	Same as R0345	
R0347, R0348	Same as R0307	
R0349	Res., 27, ±5%, 1/4W, Carbon	DRD137261
R0350	Res., 1K, VAR., 0.2W, Carbon	DRV145891
R0351	Same as R0349	
R0352	Same as R0337	
R0353	Res., 22, ±1%, 1/4W, Metal	DRE137481
R0354	Res., 56, ±1%, 1/4W, Metal	DRE137581
R0355, R0356	Same as R0307	
R0357	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R0358	Same as R0357	
R0360	Res., 27K, ±5%, 1/4W, Carbon	DRD137981
R0361	Res., 910, ±1%, 1/4W, Metal	DRE137871
R0362	Same as R0361	
R0363	Res., 150, ±1%, 1/4W, Metal	DRE137681
R0364	Res., 200, ±20%, 1/2W, Cermet	DRV415511
R0365	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R0366	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R0367	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R0368	TH., 112102-2	DDD080421
R0369	Same as R0367	
R0370, R0371	Same as R0354	
R0372, R0373	Same as R0307	
R0374	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0375	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R0376	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R0377, R0378	Same as R0334	
R0379	Res., 6.8K, ±1%, 1/4W, Metal	DRE138081
R0380	Same as R0379	
R0381	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0382 to R0384	Same as R0381	
R0386	Same as R0304	
R0387	Res., 560, ±1%, 1/4W, Metal	DRE137821
R0388	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R0389	Same as R0320	
R0390	Res., 12K, ±1%, 1/4W, Metal	DRE138141
R0391	Same as R0390	
R0392	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R0394	Res., 430, ±1%, 1/4W, Metal	DRE137791
R0395	Same as R0392	
R0396	Res., 47, ±1%, 1/4W, Metal	DRE137561
R0397	Res., 680, ±1%, 1/4W, Metal	DRE137841
R0398	Same as R0397	
R03100	Same as R0320	
R03101	Same as R0381	
R03102, R03103	Same as R0326	
R03104, R03105	Same as R0334	
R03106	Res., 470, ±1%, 1/4W, Metal	DRE137801
R03107, R03108	Same as R0397	
R03109	Same as R0396	
R03110	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R03111	Same as R0397	
R03112	Same as R03110	
R03113	Same as R0397	
R03114	Res., 10K, Var., 0.3W, Metal glazed	DRV412151
R03115	Res., 5.1K, ±1%, 1/4W, Metal	DRE138051
R03116	Res., 5.6K, ±1%, 1/4W, Metal	DRE138061
R03117	Same as R03116	
R03118	Res., 120, ±5%, 1/4W, Carbon	DRD137421
R03119	Same as R0381	
R03120	Res., 1.2K, ±1%, 1/4W, Metal	DRE137901

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R03121	Same as R03120	
R03122	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R03123	Same as R0307	
R03126	Res., 6.2K, ±5%, 1/4W, Carbon	DRD137831
R03127	Res., 2.0K, ±5%, 1/4W, Carbon	DRD137711
R03128	Res., 50K, VAR., 0.3W, Metal glazed	DRV412111
R03129	Res., 15K, ±5%, 1/4W, Carbon	DRD137921
D0302	Diode, 1S 1544A	DDD010801
D0303	Same as D0302	
D0304	Diode, 1SS 120 TA21R	DDD019071
D0305, D0310	Same as D0304	
D0311	Diode array, DAP 201	DDD991081
D0312	Same as D0311	
D0313	Diode, RD6.8ESB/HZS6.8NB TA21R	DDD038731
Q0301	Transistor, μ-PA 61AL	DTR295361
Q0302	Transistor, 2SC 1907 TR	DTR139061
Q0303 to Q0305	Same as Q0102	
Q0306	Transistor, 2SA 1206 TRC	DTR119041
Q0307	Same as Q0306	
Q0308 to Q0314	Same as Q0302	
Q0315 to Q0318	Same as Q0306	
Q0319, Q0320	Same as Q0302	
Q0321, Q0322	Same as Q0306	
Q0327	Transistor, 2SA 1015Y TPER1	DTR119011
Q0328	Same as Q0327	
Q0329	Same as Q0306	
Q0330, Q0331	Same as Q0302	
J0301	Connector, ZC-040	DCN032721
J0303	Connector, M31M87-07	DCN034501
J0304	Connector, M36M87-02	DCN034601
P0303	Connector, M33-07-30-114P	DCN034691
P0304	Connector, M36-02-30-114P	DCN034851
FL0301	Flat cable, SMCD40x80ADx10 (2.7)-P1.25	KHB088811

DS-6612

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C0401	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0402	Cap., 2p, −20 ~ +80%, 50V, Cer.	DCC259111
C0403	Cap., 1000p, ±10%, 500V, Cer.	DCC159011
C0404	Cap., 120p, ±5%, 50V, Cer.	DCC239261
C0405	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C0406	Same as C0401	
C0407	Same as C0405	
C0408, C0809	Same as C0401	
C0410	Same as C0405	
C0411, C0412	Same as C0401	
C0413	Cap., (2 ~ 8)p, Var., 250V, Cer.	DCV019612
C0414, C0415	Cap., 680, ±5%, 50V, Cer.	DCC239311
C0417	Cap., 27p, ±5%, 50V, Cer.	DCC239241
C0418	Same as C0417	
C0419	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0420	Cap., 5p, ±0.25p, 50V, Cer.	DCC239301
C0423	Cap., 0.022μ, ±10%, 50V, Film	DCF121361
C0424	Same as C0401	
C0429, C0430	Same as C0401	
C0431	Same as C0404	
C0432, C0433	Same as C0419	
C0434, C0435	Same as C0401	
C0436	Same as C0405	
C0437	Same as C0401	
C0441	Same as C0405	
R0401	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R0402	Res., 1M, ±0.5%, 1/4W, Metal	DRE930221
R0403	Same as R0402	
R0404	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0407	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0408	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0409	Same as R0407	
R0420	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0421	Res., 20K, Var., 0.3W, Metal glazed	DRV412161
R0422	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0423	Res., 100, ±1%, 1/4W, Metal	DRE137641
R0424	Same as R0420	
R0425	Same as R0407	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0426	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R0427	Same as R0426	
R0428, R0429	Same as R0420	
R0430	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0431	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
R0432	Same as R0431	
R0433	Same as R0430	
R0434	Res., 270, ±1%, 1/4W, Metal	DRE137741
R0437	Res., 100, Var., 0.3W, Cermet	DRV410501
R0438	Same as R0434	
R0439	TH., 112101-2	DDD080331
R0440	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0441	Same as R0440	
R0442	Res., 68K, ±5%, 1/4W, Carbon	DRD138081
R0445	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0446	Same as R0445	
R0447, R0448	Same as R0407	
R0449	Res., 27, ±5%, 1/4W, Carbon	DRD137261
R0450	Res., 1K, Var., 0.2W, Carbon	DRV145891
R0451	Same as R0449	
R0452	Same as R0437	
R0453	Res., 22, ±1%, 1/4W, Metal	DRE137481
R0454	Res., 56, ±1%, 1/4W, Metal	DRE137581
R0455, R0456	Same as R0407	
R0457	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R0458	Same as R0457	
R0460	Res., 27K, ±5%, 1/4W, Carbon	DRD137981
R0461	Res., 910, ±1%, 1/4W, Metal	DRE137871
R0462	Same as R0461	
R0463	Res., 150, ±1%, 1/4W, Metal	DRE137681
R0464	Res., 200, Var., 1/2W, Cermet	DRV410511
R0465	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R0466	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R0467	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R0468	TH., 112102-2	DDD080421
R0469	Same as R0467	
R0470, R0471	Same as R0454	
R0472, R0473	Same as R0407	
R0474	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0475, R0476	Same as R0407	
R0477	Same as R0474	
R0478, R0479	Same as R0434	
R0480	Res., 6.8K, ±1%, 1/4W, Metal	DRE138081
R0481	Same as R0480	
R0482, R0483	Same as R0434	
R0484	Same as R0420	
R0485	Res., 470, ±1%, 1/4W, Metal	DRE137801
R0486	Same as R0420	
R0487	Res., 560, ±1%, 1/4W, Metal	DRE137821
R0488	Res., 620, ±1%, 1/4W, Metal	DRE137831
R0489	Res., 500, Var., 0.3W, Metal glazed	DRV412070
R0490	Res., 47, ±1%, 1/4W, Metal	DRE137561
R0491	Res., 680, ±1%, 1/4W, Metal	DRE137841
R0492	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R0493	Same as R0492	
R0494	Same as R0491	
R0495, R0496	Same as R0420	
R0497	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0498	Same as R0497	
R04128	Res., 20K, VAR., 0.3W, Metal	DRV412161
R04129	Res., 15K, ±5%, 1/4W, Carbon	DRD137941
D0401	Diode, 1SS 120 TA21R	DDD019071
D0402	Diode, 1S 1544A	DDD010801
D0403	Same as D0402	
D0404, D0405	Same as D0401	
D0411	Diode array, DAP 201	DDD991081
D0412	Same as D0411	
Q0401	Transistor, μ-PA 61AL	DTR295361
Q0402	Transistor, 2SC 1907 TR	DTR139061
Q0403 to Q0405	Same as Q0402	
Q0406	Transistor, 2SA 1206 TRC	DTR119041
Q0407	Same as Q0406	
Q0408 to Q0413	Same as Q0402	
Q0414, Q0415	Same as Q0406	
Q0416, Q0417	Same as Q0402	
Q0418	Transistor, DTC 114-A	DTR190941
Q0420, Q0421	Same as Q0402	
Q0422, Q0423	Same as Q0406	
Q0424	Transistor, 2SA 1015Y TPER1	DTR119011
RL0401	Relay, G5Y-1004M	DKD026091

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6411		
C0402	Cap., 4p, ±0.25p, 50V, Cer.	DCC239201
C0403	Cap., 1000p, ±10%, 500V, Cer.	DCC159011
C0404	Cap., 120p, ±5%, 50V, Cer.	DCC239261
C0405	Cap., 22μ, ±30%, 25V, Elect.	DCE225321
C0406	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0407	Same as C0405	
C0408, C0409	Same as C0406	
C0410	Same as C0405	
C0411, C0412	Same as C0406	
C0413	Cap., (2 ~ 8)p, Var., 250V, Cer.	DCV019612
C0414	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C0415	Same as C0414	
C0417	Cap., 27p, ±5%, 50V, Cer.	DCC239241
C0418	Same as C0417	
C0419	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0423	Cap., 0.022μ, ±10%, 50V, Film	DCF121361
C0424	Same as C0406	
C0429, C0430	Same as C0406	
C0431	Same as C0404	
C0432, C0433	Same as C0419	
C0434, C0435	Same as C0406	
C0436	Same as C0405	
C0437	Same as C0406	
C0441	Same as C0405	
R0402	Res., 1M, ±0.5%, 1/4W, Metal	DRE930221
R0403	Res., 470K, ±5%, 1/2W, Carbon	DRD148281
R0404	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0407	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0408	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0409	Same as R0407	
R0420	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0421	Res., 20K, Var., 0.3W, Metal glazed	DRV412161
R0422	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0423	Res., 100, ±1%, 1/4W, Metal	DRE137641
R0424	Same as R0420	
R0425	Same as R0407	
R0426	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R0427	Same as R0426	
R0428, R0429	Same as R0420	
R0430	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0431	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
R0432	Same as R0431	
R0433	Same as R0430	
R0434	Res., 270, ±1%, 1/4W, Metal	DRE137741
R0437	Res., 100, Var., 1/2W, Metal	DRV410501
R0438	Same as R0434	
R0439	TH., 112101-2	DDD080331
R0440	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0441	Same as R0440	
R0442	Res., 68K, ±5%, 1/4W, Carbon	DRD138081
R0445	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0446	Same as R0445	
R0447	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0448	Same as R0447	
R0449	Res., 27, ±5%, 1/4W, Carbon	DRD137261
R0450	Res., 1K, VAR., 0.2W, Carbon	DRV145891
R0451	Same as R0449	
R0452	Same as R0437	
R0453	Res., 22, ±1%, 1/4W, Metal	DRE137481
R0454	Res., 56, ±1%, 1/4W, Metal	DRE137581
R0455, R0456	Same as R0407	
R0457	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R0458	Same as R0457	
R0460	Res., 27K, ±5%, 1/4W, Carbon	DRD137981
R0461	Res., 910, ±1%, 1/4W, Metal	DRD137871
R0462	Same as R0461	
R0463	Res., 150, ±5%, 1/4W, Metal	DRE137681
R0464	Res., 200, Vor., 1/2W, Metal	DRV410511
R0465	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R0466	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R0467	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R0468	TH., 112102-2	DDD080421
R0469	Same as R0467	
R0470, R0471	Same as R0454	
R0472, R0473	Same as R0407	
R0474	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0475, R0476	Same as R0407	
R0477	Same as R0474	
R0478, R0479	Same as R0434	
R0480	Res., 6.8K, ±1%, 1/4W, Metal	DRE138081

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0481	Same as R0480	
R0482, R0483	Same as R0434	
R0484	Same as R0420	
R0485	Res., 470, ±1%, 1/4W, Metal	DRE137801
R0486	Same as R0420	
R0487	Res., 560, ±1%, 1/4W, Metal	DRE137821
R0488	Res., 620, ±1%, 1/4W, Metal	DRE137831
R0489	Res., 500, Var., 0.3W, Metal glazed	DRV412071
R0490	Res., 47, ±1%, 1/4W, Metal	DRE137561
R0491	Res., 680, ±1%, 1/4W, Metal	DRE137841
R0492	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R0493	Same as R0492	
R0494	Same as R0491	
R0495, R0496	Same as R0420	
R0497	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0498	Same as R0497	
R04128	Res., 20K, VAR., 0.3W, Metal	DRV412161
R04129	Res., 15K, ±5%, 1/4W, Carbon	DRD137941
D0402	Diode, 1S 1544A	DDD010801
D0403	Same as D0402	
D0404	Diode, 1SS 120 TA21R	DDD019071
D0405	Same as D0404	
D0411	Diode array, DAP 201	DDD991081
D0412	Same as D0411	
Q0401	Transistor, μ-PA 61AL	DTR295361
Q0402	Transistor, 2SC 1907 TR	DTR139061
Q0403 to Q0405	Same as Q0402	
Q0406	Transistor, 2SA 1206 TRC	DTR119041
Q0407	Same as Q0406	
Q0408 to Q0413	Same as Q0402	
Q0414, Q0415	Same as Q0406	
Q0416, Q0417	Same as Q0402	
Q0420, Q0421	Same as Q0402	
Q0422 to Q0424	Same as Q0406	

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C0501	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0502	Same as C0501	
C0515	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0516	Cap., (20.5 ~ 3.3)p, Var., 250V, Cer.	DCV019672
C0517	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C0518	Same as C0515	
C0519	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0520	Same as C0519	
C0521	Cap., 20.5p, Var., 250V, Cer.	DCV019681
C0522	Cap., 150, ±5%, 50V, Cer.	DCC239221
C0523	Cap., 100p, ±5%, 50V, Cer.	DCC239051
C0524, C0525	Same as C0522	
C0527 to C0529	Same as C0515	
C0530 to C0532	Same as C0517	
C0533 to C0535	Same as C0515	
C0540, C0541	Same as C0523	
C0542	Cap., 560, ±5%, 50V, Cer.	DCC239251
C0543	Same as C0515	
C0550	Cap., 2200p, ±10%, 50V, Film	DCF121241
C0551	Same as C0523	
R0501	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R0502	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R0503	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0504	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0505	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R0510	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0511	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0512	Same as R0511	
R0513	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0514	Same as R0513	
R0515	Res., 5.6K, ±5%, 1/4W, Carbon	DRD137821
R0516	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R0517	Res., 5.1K, ±5%, 1/4W, Carbon	DRD137811
R0518	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0519, R0520	Same as R0510	
R0521, R0522	Same as R0511	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0523, R0524	Same as R0513	
R0525	Same as R0515	
R0526	Same as R0516	
R0527	Same as R0517	
R0528	Same as R0518	
R0529	Same as R0510	
R0530	Same as R0516	
R0531, R0532	Same as R0511	
R0533	Res., 10K, Var., 0.3W, Metal glazed	DRV411991
R0534	Res., 5.6K, ±1%, 1/4W, Metal	DRE138061
R0535	Res., 50K, Var., 0.3W, Metal glazed	DRE412061
R0536	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R0537	Same as R0536	
R0538	Res., 360, ±1%, 1/4W, Metal	DRE137771
R0539	Same as R0538	
R0540	Same as R0513	
R0541	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R0542	Same as R0513	
R0543	Res., 3.3K, ±5%, 1/4W, Carbon	DRD137761
R0544	Same as R0516	
R0545	Same as R0510	
R0546	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0547	Same as R0546	
R0548	Same as R0515	
R0549	Same as R0516	
R0550	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0551	Same as R0550	
R0552	Res., 390, ±5%, 1/4W, Carbon	DRD137541
R0553	Same as R0552	
R0554	Res., 330, ±1%, 1/4W, Metal	DRE137761
R0555	Res., 110, ±5%, 1/4W, Carbon	DRD137411
R0556	Same as R0554	
R0557, R0558	Same as R0552	
R0559	Res., 390, ±1%, 1/4W, Metal	DRE137781
R0560	Res., 1K, Var., 0.3W, Metal glazed	DRV412081
R0561	Res., 7.5K, ±5%, 1/4W, Carbon	DRD137851
R0562	Res., 39K, ±5%, 1/4W, Carbon	DRD138021
R0563	Same as R0559	
R0564	Res., 68, ±1%, 1/4W, Metal	DRE137601
R0565	Same as R0564	
R0566	Same as R0516	
R0570	Res., 1.0M, ±5%, 1/4W, Carbon	DRD138361
R0571	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0572	Same as R0559	
R0573	Res., 100, Var., 0.3W, Metal glazed	DRV412121
R0574	Res., 30, ±1%, 1/4W, Metal	DRE137511
R0575	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R0576	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R0577	Same as R0576	
R0578, R0579	Same as R0511	
R0580	Res., 330K, ±5%, 1/4W, Carbon	DRD138231
R0581	Res., 390K, ±5%, 1/4W, Carbon	DRD138261
D0502	Diode, 1SS 97	DDD010451
D0503	Same as D0502	
D0504	Diode, 1K34A	DDD010101
D0505 to D0507	Same as D0504	
D0508	Diode array DAP201	DDD991081
D0509	Diode, 1SS 120 TA21R	DDD019071
Q0501	Transistor, 2SC 1815GR TPER1	DTR139011
Q0502	Same as Q0501	
Q0503	Transistor, 2SC 1907 TR	DTR139061
Q0504 to Q0506	Same as Q0503	
Q0507, Q0508	Same as Q0501	
Q0509 to Q0512	Same as Q0503	
Q0513, Q0514	Same as Q0501	
Q0520	Transistor, 2SA 1015Y TPER1	DTR119011
Q0521	Transistor, 2SA 1206 TRC	
Q0522	Same as Q0521	
Q0523, Q0524	Same as Q0503	
Q0525, Q0526	Same as Q0501	
Q0527	Transistor, 2SC 1907 TR	DTR139061
Q0528	Same as Q0527	
Q0529	Transistor, 2SC 2037	DTR137591
Q0530	Same as Q0529	
Q0550	Transistor, 2SC 1815GR TPER1	DTR139011
IC0501	IC., TC 4069UBP	DIC420621
IC0502	IC., TC 4011BP	DIC420101
IC0503	IC., TC 4520BP	DIC422081
S0501	Switch, SVJ55A	DSW014731

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
J0502	Connector, ZC-020	DCN032701
J0505	Connector, M36M87-03	DCN034611
J0506	Same as J0505	
J0511	Connector, ZC-116	DCN032761
J0501	Connector, ZC-140	DCN032801
J0504	Connector, M36-M87-02	DCN034601
J0507	Connector, M36M87-02	DCN034601
J0521	Same as J050501	
P0503	Connector, M33-04-30-114P	DCN034661
P0504	Connector, M36-02-30-114P	DCN034851
P0505	Connector, M36-03-30-114P	DCN034861
P0506	Connector, M36-03-30-134P	DCN034911
P0507	Connector, M36-02-30-114P	DCN034851
X0501	Ceramic Resohator, CSB 256D	DHF990271
FL0502	Flat cable SMCD-20x80-ADX10(2.7)P1.25	KHB087911
FL0511	Flat cable SMCD-16x120-ADx10(2.7)P1.25	KHB088111
DL0501	Delay line, CD-3A-PE80CM	KHB048111

DS-6612

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C0601	Cap., (20.5 ~ 3.3)p, Var., 250V, Cer.	DCV019592
C0603	Cap., 33p, ±5%, 50V, Cer.	DCC239011
C0604	Cap., 330p, ±5%, 50V, Cer.	DCC239181
C0605	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0608	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0609	Same as C0608	
C0612 to C0613	Same as C0608	
C0641	Same as C0601	
C0643	Same as C0603	
C0644	Same as C0604	
C0645	Same as C0605	
C0648, C0649	Same as C0608	
C0652, C0653	Same as C0608	
C0682	Cap., 680, ±5%, 50V, Cer.	DCC239311
R0601	Res., 220, ±1%, 1/4W, Metal	DRE137721
R0602	Same as R0601	
R0603	Res., 3.3K, ±5%, 1/4W, Carbon	DRD137761
R0604	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0605	Same as R0604	
R0606	Res., 560, ±1%, 1/4W, Metal	DRE137821
R0608	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0609	Same as R0608	
R0610	Res., 680, ±1%, 1/4W, Metal	DRE137841
R0611	Same as R0610	
R0612	Res., 120, ±5%, 1/4W, Carbon	DRD137421
R0613	Same as R0612	
R0614, R0615	Same as R0604	
R0616	Res., 200, Var., 0.3W, Metal glazed	DRV412011
R0617	Res., 390, ±1%, 1/4W, Metal	DRE137781
R0618	Same as R0617	
R0619	Res., 910, ±1%, 1/4W, Metal	DRE137871
R0620	Same as R0619	
R0623	Res., 470, ±1%, 1/4W, Metal	DRE137801
R0624	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0625	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R0626	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0627	Res., 470, ±5%, 1/4W, Carbon	DRD137561

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0628	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0629	Same as R0626	
R0630	Same as R0627	
R0631	Res., 22, ±5%, 1/4W, Carbon	DRD137241
R0632	Same as R0631	
R0633	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R0634	Res., 5K, Var., 0.3W, Metal glazed	DRV412051
R0636	Res., 12K, ±5%, 1/4W, Carbon	DRD137901
R0637	Res., 33K, ±5%, 1/4W, Carbon	DRD138001
R0638	Res., 56K, ±1%, 1/4W, Metal	DRE138301
R0641, R0642	Same as R0601	
R0643	Same as R0603	
R0644, R0645	Same as R0604	
R0646	Same as R0606	
R0647	Same as R0607	
R0648, R0649	Same as R0608	
R0650, R0651	Same as R0610	
R0652	Res., 110, ±5%, 1/4W, Carbon	DRD137411
R0653	Same as R0652	
R0654, R0655	Same as R0604	
R0656	Same as R0616	
R0657, R0658	Same as R0617	
R0659, R0660	Same as R0619	
R0663	Same as R0623	
R0664	Same as R0624	
R0665	Same as R0625	
R0666	Same as R0626	
R0667	Same as R0627	
R0668	Same as R0628	
R0669	Same as R0626	
R0670	Same as R0627	
R0671, R0672	Same as R0631	
R0673	Same as R0633	
R0674	Same as R0634	
R0676	Same as R0636	
R0677	Same as R0637	
R0678	Same as R0638	
R0682	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0683	Same as R0682	
R0684	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R0686 to R0689	Same as R0682	
R0696	Same as R0682	
R0697	Same as R0603	
R0698	Res., 33K, ±5%, 1/4W, Carbon	DRD138001
R0699	Thermistor, 112103-2	DDD080431
D0601	Diode, S3162	DDD011001
D0602	Same as D0601	
D0603	Diode, 1SS 120 TA21R	DDD019071
D0604 to D0606	Same as D0603	
D0641, D0642	Same as D0601	
D0643 to D0646	Same as D0603	
D0680	Diode, RD6.8 ESB/HZS6.8NB TA21R	DDD038731
D0681 to D0686	Same as D0603	
Q0601	Transistor, 2SA 1206 TRC	DTR119041
Q0602 to Q0604	Same as Q0601	
Q0605	Transistor, 2SC 2570A	DTR137671
Q0606	Same as Q0605	
Q0607	Transistor, 2SC 1907 TR	DTR139061
Q0608	Same as Q0601	
Q0609	Transistor, 2SA 1015Y TPER1	DTR119011
Q0641 to Q0644	Same as Q0601	
Q0645 to Q0646	Same as Q0605	
Q0647	Same as Q0607	
Q0648	Same as Q0601	
Q0649	Same as Q0609	
Q0681	Same as Q0609	
Q0682	Transistor, 2SC 1815GR TPER1	DTR139011
Q0683	Same as Q0682	
IC0601	IC., TC4027BAP	DIC420261
IC0602	IC., MC 74HC00N	DIC440011
IC0603	IC., MC 74HC10N	DIC440111
J0601	Connector, M36M87-03	DCN034611
J0602	Same as J0601	
J0603	Connector, M36M87-02	DCN034601
J0604	Same as J0603	
J0605	Connector, ZC-120	DCN032781
P0601	Connector, M36-03-30-134P	DCN034911
P0602	Same as P0601	
P0603	Connector, M36-02-30-134P	DCN034901
P0604	Same as P0603	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6411		
C0605	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0608	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0609	Same as C0608	
C0612, C0613	Same as C0608	
C0645	Same as C0605	
C0648, C0649	Same as C0608	
C0652, C0653	Same as C0608	
C0682	Cap., 68p, ±5%, 50V, Cer.	DCC139501
R0601	Res., 220, ±1%, 1/4W, Metal	DRE137721
R0602	Same as R0601	
R0603	Res., 3.3K, ±5%, 1/4W, Carbon	DRD137761
R0604	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0605	Same as R0604	
R0606	Res., 47, ±1%, 1/4W, Metal	DRE137561
R0607	Res., 100, Var., 0.3W, Metal glazed	DRV412001
R0608	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0609	Same as R0608	
R0610	Res., 680, ±1%, 1/4W, Metal	DRE137841
R0611	Same as R0610	
R0612	Res., 160, ±5%, 1/4W, Carbon	DRD137451
R0613	Same as R0612	
R0614 to R0615	Same as R0604	
R0616	Res., 200, Var., 0.3W, Metal glazed	DRV412011
R0617	Res., 390, ±1%, 1/4W, Metal	DRE137781
R0618	Same as R0617	
R0619	Res., 1.2K, ±1%, 1/4W, Metal	DRE137901
R0620	Same as R0619	
R0623	Res., 470, ±1%, 1/4W, Metal	DRE137801
R0624	Res., 1.3K, ±1%, 1/4W, Metal	DRE137911
R0625	Res., 910, ±1%, 1/4W, Metal	DRE137871
R0626	Same as R0604	
R0627	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0628	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0629	Same as R0604	
R0630	Same as R0627	
R0631	Res., 22, ±5%, 1/4W, Carbon	DRD137241
R0632	Same as R0631	
R0638	Res., 56K, ±1%, 1/4W, Metal	DRE138301
R0641, R0642	Same as R0601	
R0643	Same as R0603	
R0644, R0645	Same as R0604	
R0646	Same as R0606	
R0647	Same as R0607	
R0648, R0649	Same as R0608	
R0650, R0651	Same as R0610	
R0652, R0653	Same as R0612	
R0654, R0655	Same as R0604	
R0656	Same as R0616	
R0657, R0658	Same as R0617	
R0659, R0660	Same as R0619	
R0663	Same as R0623	
R0664	Same as R0624	
R0665	Same as R0625	
R0666	Same as R0604	
R0667	Same as R0627	
R0668	Same as R0628	
R0669	Same as R0604	
R0670	Same as R0627	
R0671, R0672	Same as R0631	
R0678	Same as R0638	
R0682, R0683	Same as R0623	
R0684	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R0686 to R0689	Same as R0623	
D0603	Diode, 1SS 120 TA21R	DDD019071
D0604 to D0606	Same as D0603	
D0643 to D0646	Same as D0603	
D0680	Diode, RD6.8ESB/HZS6.8NB TA21R	DDD038731
D0681 to D0686	Same as D0603	
Q0601	Transistor, 2SA 1206 TRC	DTR119041
Q0602 to Q0604	Same as D0601	
Q0605	Transistor, 2SC 2570A	DTR137671
Q0606	Same as D0605	
Q0607	Transistor, 2SC 1907 TR	DTR139061
Q0608	Same as D0601	
Q0609	Transistor, 2SA 1015Y TPER1	DTR19011
Q0641 to Q0644	Same as Q0601	
Q0645, Q0646	Same as Q0605	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Q0647	Same as Q0607	
Q0648	Same as Q0601	
Q0649	Same as Q0609	
Q0681	Same as Q0609	
Q0682	Transistor, 2SC 1815GR TPER1	DTR139011
Q0683		
IC0601	IC., TC 4027BAP	DIC420261
IC0602	IC., MC 74HC00N	DIC440011
IC0603	IC., MC 74HC10N	DIC440111
P0601	Connector, M36-03-30-134P	DCN034911
P0602	Same as P0601	
P0603	Connector, M36-02-30-134P	DCN034901
P0604	Same as P0603	
J0601	Connector, M36-M87-03	DCN034611
J0602	Same as J0601	
J0603	Connector, M36-02-30-134P	DCN034601
J0604	Same as J0603	
J0605	Connector, ZC-120	DCN032781

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C0701	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C0702	Cap., 150p, ±5%, 50V, Cer.	DCC239021
C0703	Cap., 390, ±5%, 50V, Cer.	DCC239371
C0704	Cap., 1μ, ±20%, 50V, Elect.	DCE249311
C0705	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0707	Cap., (5 ~ 40)p, Var., 250V, Cer.	DCV019752
C0708	Cap., 0.01μ, ±10%, 50V, Film	DCF121321
C0709	Same as C0705	
C0710	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0711	Same as C0710	
C0712	Cap., 180p, ±5%, 50V, Cer.	DCC239271
C0713	Same as C0712	
C0714	Same as C0705	
C0715	Cap., 0.01μ, ±10%, 500V, Cer.	DCC153561
C0716	Cap., 470, ±5%, 50V, Cer.	DCC239031
C0717	Same as C0716	
C0718	Same as C0705	
C0719	Same as C0710	
C0720	Same as C0705	
C0743	Cap., 22μ, ±20%, 25V, Elect.	DCE249311
C0745	Same as C0743	
C0747	Same as C0743	
R0701	Res., 5K, Var., 0.3W, Metal glazed	DRV412051
R0702	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R0703 to R0705	Same as R0702	
R0706	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R0707	Same as R0706	
R0710	Same as R0702	
R0712	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
R0713	TH., 112101-2	DDD080331
R0714	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R0715	Res., 47K, ±1%, 1/4W, Metal	DRE138281
R0716	Res., 20K, Var., 0.3W, Metal glazed	DRV412161
R0717	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R0720	Res., 560, ±1%, 1/4W, Metal	DRE137821
R0721	Same as R0706	
R0722, R0723	Same as R0714	
R0724	Res., 430, ±1%, 1/4W, Metal	DRE137791

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0725	Same as R0724	
R0726	Res., 27, ±1%, 1/4W, Metal	DRE137501
R0727	Same as R0726	
R0728	Res., 6.8K, ±5%, 1/4W, Carbon	DRD137841
R0729	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0730	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0731, R0732	Same as R0730	
R0733	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0740	Res., 68, ±5%, 1/4W, Carbon	DRD137361
R0741	Same as R0740	
R0742	Res., 11K, ±1%, 1/4W, Metal	DRE138131
R0743	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R0744	Same as R0743	
R0745	Res., 160, ±5%, 1/4W, Carbon	DRD137451
R0750	Res., 100, ±1%, 1/4W, Metal	DRE137641
R0751, R0752	Same as R0750	
R0753	Res., 390, ±1%, 1/4W, Metal	DRE137781
R0754	Res., 200, VAR., 0.3W, Metal glazed	DRV412011
R0755	Res., 470, ±1%, 1/4W, Metal	DRE137801
R0756	Res., 1.8K, ±5%, 1/4W, Carbon	DRD137701
R0757	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R0758	Same as R0730	
R0759	Same as R0728	
R0760	Res., 3.3K, ±5%, 1/4W, Carbon	DRD137761
R0761	Res., 180, ±1%, 1/4W, Metal	DRE137701
R0762	Same as R0761	
R0763	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0764	Res., 82, ±5%, 1/4W, Carbon	DRD137381
R0765	Same as R0764	
R0766	Res., 1K, Var., 0.3W, Metal glazed	DRV412031
R0767	Res., 68K, ±5%, 1/4W, Carbon	DRD138081
R0770	Same as R0750	
R0771	Res., 750, ±1%, 1/4W, Metal	DRE137851
R0772	Same as R0771	
R0773	Res., 430, ±5%, 1/4W, Carbon	DRD137551
R0774	Same as R0766	
R0775	Res., 75, ±1%, 1/4W, Metal	DRE137611
R0776	Res., 220, ±1%, 1/4W, Metal	DRE137721
R0777	Same as R0776	
R0778 to R0781	Same as R0775	
R0782	Res., 82, ±1%, 1/4W, Metal	DRE137621
R0783	Res., 12K, ±5%, 1/4W, Carbon	DRD137901
R0784	TH., 112502-2	DDD080191
R0785	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R0786	Same as R0702	
R0787	Same as R0785	
R0788	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R0789	Res., 240, ±2%, 1/2W, Metal	DRE163581
R0790 to R0792	Same as R0789	
R0793	Same as R0788	
R0794	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0795	Same as R0794	
D0702	Diode, S3162	DDD011001
D0703	Same a D0702	
D0704	Diode, 1SS 120 TA21R	DDD019071
D0705, D0706	Same as D0704	
D0707	Diode, 1SS 97 TA21R	DDD019101
D0708	Same as D0707	
D0710, D0711	Same as D0704	
Q0702	Transistor, 2SC 3064	DTR135871
Q0708	Transistor, 2SA 1015Y TPER1	DTR119011
Q0709	Same as Q0708	
Q0710	Transistor, 2SA 1237G	DTR116321
Q0711	Same as Q0708	
Q0713	Transistor, 2SC 1815GR TPER1	DTR139011
Q0714	Same as Q0713	
Q0715	Transistor, 2SA 1206 TRC	DTR119041
Q0716, Q0717	Same as Q0715	
Q0718, Q0719	Same as Q0708	
Q0720	Same as Q0715	
Q0721	Transistor, 2SC 2570A	DTR137671
Q0722	Same as Q0721	
Q0723	Transistor, 2SC 3595	DTR137451
Q0724	Same as Q0723	
Q0725	Transistor, 2SC 3597	DTR135771
Q0726	Same as Q0725	
IC0701	IC., MC 74HC02N	DIC440031
IC0702	IC., CD 4053BE	DIC410521
J0701	Connector, M36M87-06	DCN034641

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
J0702	Connector, M31M87-15	DCN034551
P0701	Connector, M36-06-30-134P	DCN034941
P0702	Connector, M33-15-30-114P	DCN034741
P0703	Connector, M33-04-30-114P	DCN034661
L0701	Peaking coil	DCL151301
L0702	Same as L0703	
L0703	Choke coil 82007	DCL111331
L0704	Same as L0701	

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C0801	Cap., 82p, ±5%, 100V, Cer.	DCC249501
C0802	Cap., 2.2μ, ±20%, 50V, Elect.	DCE249321
C0803	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C0804	Cap., 1500p, ±10%, 50V, Film	DCF121221
C0805	Cap., 0.022μ, ±10%, 50V, Film	DCF121361
C0806	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0807	Cap., 0.1μ, ±20%, 50V, Cer.	DCC139551
C0808	Cap., 0.01μ, ±10%, 50V, Film	DCF121321
C0809	Same as C0807	
C0810	Cap., 0.1μ, ±5%, 50V, Film	DCF121841
C0811	Cap., 3300p, ±5%, 50V, Film	DCF121661
C0812	Same as C0807	
C0820	Same as C0803	
C0821	Cap., 0.047μ, ±20%, 400V, Film	DCF168011
C0822	Cap., 18p, ±5%, 50V, Cer.	DCC239111
C0823	Cap., 1000p, ±10%, 500V, Cer.	DCC159011
C0824	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0825, C0826	Same as C0824	
C0827	Same as C0803	
C0828	Cap., 47p, ±5%, 50V, Cer.	DCC239031
C0829 to C0831	Same as C0824	
C0832	Cap., 20.5p, Var., 250V, Cer.	DCV019681
C0833	Cap., 33p, ±5%, 50V, Cer. (DS-6612 only)	DCC239011
C0834 to C0841	Same as C0803	
C0850 to C0855	Same as C0824	
C0856	Same as C0804	
C0856	Same as C0803	
C0857	Same as C0824	
R0801	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0802	Res., 12K, ±5%, 1/4W, Carbon	DRD137901
R0803	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R0804	Res., 18K, ±5%, 1/4W, Carbon	DRD137941
R0805	Same as R0801	
R0806	Res., 3.3K, ±5%, 1/4W, Carbon	DRD137761
R0807	Same as R0801	
R0808	Res., 470K, ±5%, 1/4W, Carbon	DRD138281
R0809	Same as R0801	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0810	Res., 270, ±5%, 1/4W, Carbon	DRD137501
R0811	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R0812	Same as R0811	
R0813	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R0814	Res., 2.7K, ±5%, 1/4W, Carbon	DRD137741
R0815	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R0816	Res., 1.0, ±20%, 1/4W, Carbon	DRD138361
R0817	Same as R0808	
R0818	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0819	Res., 330K, ±5%, 1/4W, Carbon	DRD138241
R0820	Same as R0803	
R0821	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R0822	Same as R0821	
R0823	Same as R0818	
R0830	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R0831	Res., 4.7, ±5%, 1/4W, Carbon	DRD137081
R0832	Res., 1.0M, ±1%, 1/4W, Metal	DRE138601
R0833	Res., 680, ±5%, 1/4W, Carbon	DRD138321
R0834	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R0835	Res., 6.8K, ±5%, 1/4W, Carbon	DRD137841
R0836	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R0837	Res., 200, Var., 0.3W, Metal glazed	DRV412201
R0838	Same as R0830	
R0839	Res., 75, ±1%, 1/4W, Metal	DRE137611
R0840	Res., 200, Var., 0.3W, Metal glazed	DRV412201
R0841	Res., 100, ±5%, 1/4W, Carbon	DRD137431
R0842	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R0843	Same as R0841	
R0844	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R0845 (DS-6612)	Res., 130, ±5%, 1/4W, Carbon	DRD137431
R0845 (DS-6411)	Res., 240, ±5%, 1/4W, Carbon	DRD137491
R0846	Same as R0806	
R0847	Same as R0842	
R0848	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0849, R0850	Same as R0844	
R0851	Res., 5.1K, ±5%, 1/4W, Carbon	DRD137281
R0852	Same as R0851	
R0853	Same as R0842	
R0854	Same as R0844	
R0855	Same as R0821	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0856	Same as R0813	
R0857	Same as R0821	
R0858	Same as R0830	
R0860	Same as R0803	
R0861	Same as R0841	
R0862	Same as R0821	
R0863	Res., 56, ±5%, 1/4W, Carbon	DRD137341
R0864	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R0865	Same as R0863	
R0866	Same as R0821	
R0867	Same as R0848	
R0868, R0869	Same as R0863	
R0870	Same as R0848	
R0871	Res., 470, ±1%, 1/4W, Metal	DRE137801
R0872	Res., 150, ±1%, 1/4W, Metal	DRE137681
R0873	Same as R0872	
R0880	Same as R0821	
RA0801	Resistors array, 10K, ±5%, 1/5W, Metal	DFB015861
D0801	Diode, 1K34A	DDD010101
D0802	Diode, 1SS 120 TA21R	DDD019071
D0803	Same as D0802	
D0804	Diode, 1S 1544A	DD010801
D0805	Same as D0804	
D0806	Diode, RD6.2ESB/HZS6.2NB TA21R	DDD038721
D0807	Diode, RD2.0ESB/HZS2.0NB TA21R	DDD038601
D0808	Diode, RD3.0ESB/HZS3.0NB TA21R	DDD038641
D0810, D0811	Same as D0802	
D0812	Diode, array, DAP201	DDD991081
D0813	Same as D0812	
D0814	Diode, RD4.7ESB/HZS4.7NB TA21R	DDD038691
D0815	Same as D0802	
Q0801	Transistor, 2SC 1815GR TPER1	DTR139011
Q0802	Same as Q0801	
Q0803	Transistor, 2SA 1015Y TPER1	DTR119011

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Q0804	Same as Q0801	
Q0805	Transistor, 2SC 982 TM	DTR130551
Q0806	Transistor, 2SC 2901	DTR135741
Q0810	Transistor, μ-PA 61AL	DTR295361
Q0811	Transistor, 2SA 1206 TRC	DTR119041
Q0812	Transistor, 2SC 1907 TR	DTR139061
Q0813	Same as Q0812	
Q0814	Same as Q0811	
Q0815	Same as Q0806	
Q0821	Transistor, 2SK 30ATM-0 TPER1	DTR219011
Q0822	Same as Q0821	
Q0823, Q0824	Same as Q0806	
Q0825	Transistor, 2SC 2037	DTR137591
Q0826	Same as Q0825	
IC0801	IC., CD 4053BE	DIC410521
IC0802	IC., SD 5001N	DIC632661
IC0803	Same as IC0802	
IC0804	IC., μ-PC 451C	DIC610101
IC0805	Same as S0804	
IC0806	IC., MC 74HC05N	DIC440061
S0801	Lever Switch, SLR024	DSW045091
S0802	Same as IC0801	
S0803	Switch, SUJ12A	DSW014831
J0801	Connector, M36M87-04	DCN034621
J0802	Connector, M36M87-05	DCN034631
J0803	Connector, M36M87-02	DCN034601
J0805	Connector, M31M87-15	DCN034551
J0810	Connector, BNC234	DCN040731
J080804	Connector, ZC-140	DCN032801
P0801	Connector, M36-04-30-114P	DCN034871
P0802	Connector, M36-05-30-114P	DCN034881
P0803	Connector, M36-02-30-114P	DCN034851
P0805	Connector, M33-15-30-114P	DCN034741
FL0804	Flat cable SMCD40x80ADx10(2.7)-P1.25	KHB088811

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C0901	Cap., 22μ, 20%, 25V, Elect.	DCE225321
C0903	Cap., 2.2M, ±20%, 50V, Elect.	DCE249321
C0904	Cap., 100p, ±5%, 50V, Cer.	DCC239051
C0905	Cap., 150p, ±5%, 50V, Cer.	DCC239021
C0906	Same as C0905	
C0907	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C0908	Cap., 120p, ±5%, 50C, Cer.	DCC239261
C0909	Same as C0904	
C0910	Cap., 15p, ±5%, 50V, Cer.	DCC239221
C0911	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C0912	Cap., 10p, ±0.5p, 50V, Cer.	DCC239041
C0913	Cap., 20.5p, Var., 250V, Cer.	DCV019681
C0914	Cap., 47p, ±5%, 50V, Cer.	DCC249511
C0915	Same as C0907	
C0916	Same as C0904	
C0917	Cap., 180p, ±5%, 50C, Cer.	DCC239271
C0918, C0919	Same as C0907	
C0920	Cap., 1000p, ±10%, 50V, Film	DCF121201
C0921	Same as C0907	
C0922	Same as C0901	
C0923, C0924	Same as C0907	
C0925, C0926	Same as C0901	
C0927	Cap., 47p, ±5%, 50V, Cer.	DCC239031
C0928	Cap., 39p, ±5%, 50V, Cer.	DCC239131
C0930	Same as C0901	
C0931	Same as C0907	
R0901	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R0902	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R0903	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R0904	Res., 180, ±5%, 1/4W, Carbon	DRD137461
R0905	Same as R0904	
R0906	Same as R0903	
R0907	Res., 56K, ±5%, 1/4W, Carbon	DRD138061
R0908	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R0909	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R0910	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R0911	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R0912	Same as R0911	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R0913	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R0914	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R0915	Same as R0913	
R0916	Res., 15K, ±5%, 1/4W, Carbon	DRD137921
R0917, R0918	Same as R0914	
R0919	Same as R0916	
R0920	Res., 390, ±1%, 1/4W, Metal	DRE137781
R0921	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R0922	Same as R0921	
R0923	Same as R0920	
R0924	Same as R0913	
R0925	Res., 15K, ±1%, 1/4W, Metal	DRE138161
R0926	Res., 1K, Var., 0.3W, Metal glazed	DRV412081
R0927	Res., 3.0K, ±1%, 1/4W, Metal	DRE137991
R0928	Res., 500K, VAR., 0.125W, Carbon	DRV146931
R0929	Same as R0908	
R0930	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R0931	Res., 430, ±5%, 1/4W, Carbon	DRD137551
R0932	Same as R0931	
R0933	Res., 91, ±5%, 1/4W, Carbon	DRD137391
R0934	Res., 750, ±5%, 1/4W, Carbon	DRD137611
R0935	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R0936	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R0937, R0938	Same as R0913	
D0901	Diode, 1SS 120 TA21R	DDD019071
D0903	Diode, 1K34A	DDD010101
D0904, D0905	Same as D0903	
D0906	Diode, 1SS 97	DDD010451
D0907	Diode, RD5.6EB TA21R	DDD032021
D0908	Diode, RD24ESB/HZS24NB TA21R	DDD038861
D0910	LED, TLR206	DDD070181
D0911 to D0912	Same as D0901	
Q0901	Transistor, 2SA 1206 TRC	DTR119041
Q0902	Same as Q0901	
Q0903	Transistor, 2SC 2901	DTR135741
Q0904	Same as Q0903	
Q0905	Transistor, 2SK 30ATM-0 TPER1	DTR219011
Q0906	Same as Q0901	
Q0907	Same as Q0905	
Q0908	Transistor, 2SC 1815GR TPER1	DTR139011
Q0909	Transistor, 2SA 1015Y TPER1	DTR119011
Q0910	Same as Q0909	
Q0911	Same as Q0908	
Q0912, Q0913	Same as Q0909	
IC0901	IC., F10107DC	DIC310051
IC0902	IC., SN 74LS123N	DIC141181
IC0903	IC., SN 74S112N	DIC170511
IC0904	IC., MC 74HC14N	DIC440151
IC0905	IC., 74F00PC	DIC198031
P0902	Connector, M36-05-30-114P	DCN034881
J0902	Connector, M36-M87-05	DCN034631

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612		
C1001	Cap., 0.01μ, ±10%, 500V, Cer.	DCC153561
C1002	Same as C1001	
C1003	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1004 to C1006	Same as C1003	
C1007	Cap., 0.01μ, ±0.25%, 50V, Film	DCF125771
C1008	Cap., 1μ, ±1%, 50V, Poly	DCF420281
C1009	Cap., 4700μ, ±10%, 50V, Film	DCF121281
C1011	Cap., 1μ, ±20%, 50V, Elect.	DCF249311
C1012	Cap., 47μ, ±20%, 50V, Elect.	DCE249301
C1013	Cap., 0.1μ, ±20%, 50V, Cer.	DCC139551
C1014	Cap., 0.015μ, ±10%, 50V, Film	DCF121341
C1015	Cap., 1500p, ±10%, 50V, Film	DCF121221
R1001	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1002	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R1003	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R1005	Res., 56K, ±5%, 1/4W, Carbon	DRD138061
R1007 to R1015	Same as R1005	
R1016	Res., 50K, ±0.5%, 1/2W, Metal	DRE938041
R1017	Res., 20K, ±0.5%, 1/4W, Metal	DRE938321
R1018	Res., 2.2M, ±0.5%, 1/4W, Carbon	DRD139831
R1019	Res., 20K, ±0.5%, 1/4W, Metal	DRE938301
R1020	Res., 500K, ±0.5%, 1/2W, Metal	DRE938071
R1021	Res., 200K, ±0.5%, 1/4W, Metal	DRE938351
R1022	Res., 100K, ±0.5%, 1/4W, Metal	DRE938331
R1023	Res., 5.0M, ±0.5%, 1/2W, Metal	DRE948051
R1024	Res., 2.0M, ±0.5%, 1/2W, Metal	DRE938381
R1025	Res., 1.0M, ±0.5%, 1/4W, Metal	DRE938371
R1026	Res., 5.0K, ±0.5%, 1/2W, Metal	DRE139971
R1028	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R1029	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1030	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1032	Res., 4.3K, ±1%, 1/4W, Metal	DRE138031
R1033	Res., 100K, VAR., 0.125W, Carbon	DRV147431
R1034	Res., 15K, ±1%, 1/4W, Metal	DRE138161
R1035	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R1036	Same as R1035	
R1037	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R1038	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1039	Same as R1001	
RA1001	Resistors array, 47K, ±5%, 1/10W, Metal	DFB018311
RA1002	Resistors array, 39K, ±5%, 1/10W, Metal	DFB018301
RA1003	Resistors array, 120K, ±5%, 1/10W, Metal	DFB018321
D1001	Diode, 1K 34A	DDD010101
D1002 to D1005	Same as D1001	
D1006	Diode, 1SS 97 TA21R	DDD019101
D1007	Same as D1001	
D1008	Diode, 1SS 120 TA21R	DDD019071
D1010 to D1012	Same as D1008	
D1014 to D1015	Same as D1001	
Q1001	Transistor, 2SC 1815GR TPER1	DTR139011
Q1002	Transistor, 2SA 992F	DTR115561
Q1003 to Q1011	Same as Q1002	
Q1012	Transistor, 2N 3905	DTR150011
Q1013	Transistor, 2SA 1015Y TPER1	DTR119011
IC1001	IC., SN 7406N	DIC110071
IC1002	IC., SN 7445N	DIC110461
IC1003	IC., MC 74HC42N	DIC440431
IC1004	IC., SN 7407N	DIC110081
IC1005	IC., SN 75451BP	DIC195011
S1001	Switch, BCM24(1-22)01/(4-22)01/100K	DSW033441
RL1001	Relay, MZ-12HS	DKD026501
RL1002	Same as RL1001	
J1001	Connector, ZC-116	DCN032761
J1011	Connector, M36M87-03	DCN034611
P1011	Connector, M36-03-30-114P	DCN034861
FL1001	Flat cable, SMCD-16X250-ADX10(2.7)P1.25	KHB088011

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6411		
C1001	Cap., 0.01μ, ±10%, 500V, Cer.	DCC153561
C1002	Same as C1001	
C1003	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1004 to C1006	Same as C1003	
C1007	Cap., 10000p, ±0.25%, 50V, Poly	DCF125771
C1008	Cap., 1μ, ±1%, 50V, Poly	DCF420281
C1009	Cap., 4700p, ±10%, 50V, Film	DCF121281
C1011	Cap., 1p, ±20p, 50V, Elect.	DCE249311
C1012	Cap., 0.47μ, ±20p, 50V, Elect.	DCE249301
C1013	Cap., 0.1μ, ±20%, 50V, Cer.	DCC139551
C1014	Cap., 0.015μ, ±10%, 50V, Film	DCF121341
C1015	Cap., 1500p, ±10%, 50V, Film	DCF121221
R1001	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1002	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R1007	Res., 56K, ±5%, 1/4W, Carbon	DRD138061
R1008 to R1015	Same as R1007	
R1016	Res., 50K, ±0.5%, 1/2W, Metal	DRE938041
R1017	Res., 20K, ±0.5%, 1/4W, Metal	DRE938321
R1018	Res., 2.2M, ±5%, 1/4W, Carbon	DRD139831
R1019	Res., 10K, ±0.5%, 1/4W, Metal	DRE938301
R1020	Res., 500K, ±0.5%, 1/2W, Metal	DRE938071
R1021	Res., 200K, ±0.5%, 1/4W, Metal	DRE938351
R1022	Res., 100K, ±0.5%, 1/4W, Metal	DRE938331
R1023	Res., 5.0M, ±0.5%, 1/2W, Metal	DRE948051
R1024	Res., 2.0M, ±0.5%, 1/4W, Metal	DRE938381
R1025	Res., 1.0M, ±0.5%, 1/4W, Metal	DRE938371
R1028	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R1029	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1030	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1032	Res., 4.3K, ±1%, 1/4W, Metal	DRE138031
R1033	Res., 100K, VAR., 0.125W, Carbon	DRV147431
R1034	Res., 15K, ±1%, 1/4W, Metal	DRE138161
R1035	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R1036	Same as R1035	
R1037	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R1038	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1039	Same as R1001	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
RA1001	Resistors array, 47K, ±5%, 1/10W, Metal	DFB018311
RA1002	Resistors array, 39K, ±5%, 1/10W, Metal	DFB018301
RA1003	Resistors array, 120K, ±5%, 1/10W, Metal	DFB018321
D1001	Diode, 1K 34A	DDD010101
D1002 to D1005	Same as D1001	
D1006	Diode, 1SS 97 TA21R	DDD019101
D1007	Same as D1001	
D1008	Diode, 1SS 120 TA21R	DDD019071
D1010 to D1012	Same as D1008	
Q1001	Transistor, 2SC 1815GR TPER1	DTR139011
Q1002	Transistor, 2SA 992F	DTR115561
Q1003 to Q1010	Same as Q1002	
Q1012	Transistor, 2N 3905	DTR150011
Q1013	Transistor, 2SA 1015Y TPER1	DTR119011
IC1001	IC., SN 7406N	DIC110071
IC1002	IC., SN 7445N	DIC110461
IC1003	IC., MC 74HC42N	DIC440431
IC1004	IC., SN 7407N	DIC110081
IC1005	IC., SN 75451BP	DIC195011
S1001	Switch, BCM24(1-21)01/(4-21)01/100K	DSW033421
RL1001	Relay, MZ-12HS	DKD026501
RL1002	Same as RL1001	
J1001	Connector, ZC-116	DCN032761
J1011	Connector, M36M87-03	DCN034611
P1011	Connector, M36-03-30-114P	DCN034861
FL1001	Flat cable SMCD-16x250-ADx10(2.7)P1.25	KHB088011

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C1101	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1102	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1103	Same as C1102	
C1104	Cap., 100p, ±5%, 50V, Cer.	DCC239051
C1105	Cap., 15p, ±5%, 50V, Cer.	DCC239221
C1106	Same as C1104	
C1107	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C1108	Cap., 22p, ±5%, 50V, Cer.	DCC239121
C1109	Cap., 20.5p, Var., 250V, Cer.	DCV019681
C1110	Cap., 47p, ±5%, 100V, Cer.	DCC249511
C1111	Same as C1101	
C1112	Same as C1104	
C1113	Cap., 180p, ±5%, 50C, Cer.	DCC239271
C1114, C1115	Same as C1101	
C1120	Same as C1101	
C1121	Same as C1102	
C1130	Cap., 150p, ±5%, 50V, Cer.	DCC239021
R1101	Res., 11K, ±1%, 1/4W, Metal	DRE138131
R1102	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R1103	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1104	Same as R1103	
R1105	Res., 15K, ±5%, 1/4W, Carbon	DRD137921
R1107	Same as R1103	
R1109	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R1110	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R1111	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R1112	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1113	Same as R1112	
R1114	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R1115	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R1116	Same as R1114 .	
R1117	Same as R1105	
R1118, R1119	Same as R1115	
R1120	Same as R1105	
R1121	Res., 220, ±1%, 1/4W, Metal	DRE137721
R1122	Res., 500, Var., 0.3W, Metal glazed	DRV412071
R1123	Res., 3.3K, ±1%, 1/4W, Metal	DRE138001
R1124	Same as R1123	
R1125	Res., 390, ±1%, 1/4W, Metal	DRE137781
R1126	Res., 390, ±5%, 1/4W, Metal	DRE138141
R1127	Res., 12K, ±1%, 1/4W, Metal	DRE138141
R1128A	Res., 3.0K, ±1%, 1/4W, Metal	DRE137991
R1128B	Res., 47K, ±1%, 1/4W, Metal	DRE138281
R1129	Res., 4.7K, ±5%, 1/4W, Metal	DRD137801
R1130	Res., 5.1K, ±5%, 1/4W, Carbon	DRD137811
R1131	Res., 3.3K, ±5%, 1/4W, Carbon	DRD137761
R1132	Same as R1103	
R1133	Res., 330, ±5%, 1/4W, Carbon	DRD137521
D1101	Diode, RD3.9EB1 TA21R	DDD032871
D1102	Diode, 1SS 120 TA21R	DDD019071
D1104	Diode, 1SS 97	DDD010451
D1105	Diode, RD5.6EB2 TA21R	DDD032021
D1106	Diode, RD24ESB/HZS24NB TA21R	DDD038861
D1107	Same as D1102	
D1108, D1109	Same as D1104	
Q1101	Transistor, 2SC 1815GR TPER1	DTR139011
Q1102	Same as Q1101	
Q1103	Transistor, 2SC 2901	DTR135741
Q1104	Same as Q1103	
Q1105	Transistor, 2SK 30A-Y	DTR210141
Q1106	Transistor, 2SA 1206 TRC	DTR119041
Q1107	Same as Q1105	
Q1108	Same as Q1101	
Q1109	Transistor, 2SA 1015Y TPER1	DTR119011
Q1110	Same as Q1101	
IC1101	IC., MC 74HC00N	DIC440011
IC1102	IC., TL 810CP	DIC630731
IC1103	IC., SN 74S112N	DIC170511
IC1104	IC., SN 74LS00N	DIC140011
P1101	Connector, M36-03-30-114P	DCN034861
J1101	Connector, M36M87-03	DCN034611

B TIMING 12

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612		
C1201	Cap., 0.01μ, ±0.25%, 50V, Film	DCF125771
C1202	Cap., 1μ, ±0.25%, 50V, Poly	DCF420281
C1203	Cap., 4700p, ±10%, 50V, Film	DCF121281
C1204	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1211	Cap., 0.01μ, ±10%, 500V, Cer.	DCC153561
C1212 to C1214	Same as C1211	
R1201	Res., 56K, ±5%, 1/4W, Carbon	DRD138061
R1202 to R1208	Same as R1201	
R1210	Res., 50K, ±0.5%, 0.3W, Metal	DRE938041
R1211	Res., 20K, ±0.5%, 1/4W, Metal	DRE938321
R1212	Res., 10K, ±0.5%, 1/4W, Metal	DRE938301
R1213	Res., 2.2M, ±5%, 1/4W, Carbon	DRD139831
R1214	Res., 500K, ±0.5%, 1/4W, Metal	DRE938071
R1215	Res., 200K, ±0.5%, 1/4W, Metal	DRE938351
R1216	Res., 100K, ±0.5%, 1/4W, Metal	DRE938331
R1218	Res., 5.0K, ±0.5%, 0.3W, Metal	DRE139971
R1219	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R1220	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1221	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1222	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R1223	Res., 2K, Var., 0.3W, Metal glazed	DRV412171
R1224	Res., 18K, ±1%, 1/4W, Metal	DRE138181
R1225	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
RA1202	Resistors array, 39K, ±5%, 1/7W, Metal	DFB018281
RA1203	Resistors array, 120K, ±5%, 1/7W, Metal	DFB018291
D1201	Diode, 1K 34A	DDD010101
D1202 to D1205	Same as D1201	
D1206	Diode, 1SS 120 TA21R	DDD019071
D1207, D1208	Same as D1206	
D1209, D1210	Same as D1201	
Q1201	Transistor, 2SC 1815GR TPER1	DTR139011
Q1202	Transistor, DTC114A	DTR190941
Q1203	Transistor, 2SA 992F	DTR115561
Q1204 to Q1209	Same as Q1203	
Q1210	Transistor, 2N 3905	DTR150011
IC1201	IC., SN 7445N	DIC110461
IC1202	IC., MC 74HC42N	DIC440431
IC1203	IC., SN 75451BP	DIC195011
RL1201	Relay, MZ-12HS	DKD026501
RL1202	Same as RL1201	
DS-6411		
C1201	Cap., 0.01μ, ±0.25%, 50V, Film	DCF125771
C1202	Cap., 1μ, ±1%, 50V, Poly	DCF420281
C1203	Cap., 4700p, ±10%, 50V, Film	DCF121281
C1204	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1211	Cap., 0.01μ, ±10%, 500V, Cer.	DCC153561
C1212	Same as C1211	
C1213, C1214	Same as C1204	
R1201	Res., 56K, ±5%, 1/4W, Carbon	DRD138061
R1202 to R1206	Same as R1201	
R1210	Res., 50K, ±0.5%, 0.3W, Metal	DRE938041
R1211	Res., 20K, ±0.5%, 1/4W, Metal	DRE938321
R1212	Res., 10K, ±0.5%, 1/4W, Metal	DRE938301
R1213	Res., 2.2M, ±5%, 1/4W, Carbon	DRD139831
R1214	Res., 500K, ±0.5%, 1/4W, Metal	DRE938071
R1215	Res., 200K, ±0.5%, 1/4W, Metal	DRE938351
R1216	Res., 100K, ±0.5%, 1/4W, Metal	DRE938331
R1219	Res., 220, ±5%, 1/4W, Carbon	DRD137481
R1220	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1221	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1222	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R1223	Res., 2K, Var., 0.3W, Metal glazed	DRV412171
R1224	Res., 18K, ±1%, 1/4W, Metal	DRE138181
RA1202	Resistors array, 39K, ±5%, 1/7W, Metal	DFB018281
RA1203	Resistors array, 120K, ±5%, 1/7W, Metal	DFB018291

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
D1201	Diode, 1K 34A	DDD010101
D1202 to D1205	Same as D1201	
D1206	Diode, 1SS 120 TA21R	DDD019071
D1207, D1208	Same as D1206	
Q1203	Transistor, 2SA 992F	DTR115561
Q1204 to Q1208	Same as Q1203	
Q1210	Transistor, 2N 3905	DTR150011
IC1201	IC., SN 7445N	DIC110461
IC1202	IC., MC 74HC42N	DIC440431
IC1203	IC., SN 75451BP	DIC195011
RL1201	Relay, MZ-12HS	DKD026501
RL1202	Same as RL1201	

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C1301	Cap., 1000p, ±10%, 50V, Film	DCF121201
C1302	Cap., 150p, ±5%, 50V, Cer.	DCC239021
C1305	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1306 to C1308	Same as C1305	
C1321 to C1325	Same as C1305	
C1326	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1327	Same as C1305	
C1328	Same as C1326	
C1353	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1357	Same as C1353	
C1358	Cap., 150p, ±5%, 50V, Cer.	DCC239021
C1361	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1362	Same as C1361	
C1363	Cap., 220p, ±5%, 50V, Cer.	DCC239171
C1364	Same as C1363	
R1301	Res., 20K, VAR., 0.125W, Carbon	DRV146951
R1302	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R1303	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R1304	Res., 1.0M, ±5%, 1/4W, Carbon	DRD138361
R1305	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R1306	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R1307	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1308	Same as R1305	
R1309	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R1310	Res., 50K, Var., 0.3W, Metal glazed	DRV412111
R1311 to R1313	Same as R1307	
R1321	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R1322	Res., 47K, ±1%, 1/4W, Metal	DRE138281
R1323	Res., 5K, Var., 0.3W, Metal glazed	DRV412091
R1324	Res., 5.1K, ±5%, 1/4W, Metal	DRE138051
R1325	Res., 2.7K, ±5%, 1/4W, Carbon	DRD137741
R1326	Res., 10K, Var., 0.3W, Metal glazed	DRV412151
R1327	Res., 6.2K, ±5%, 1/4W, Carbon	DRD137831
R1328	Res., 200, ±5%, 1/4W, Carbon	DRD137471

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R1352	Res., 560, ±5%, 1/4W, Carbon	DRD137581
R1353	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R1355	Res., 1K, Var., 0.3W, Metal glazed	DRV412081
R1356	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R1357	Res., 5K, Var., 0.3W, Metal glazed	DRV412091
R1358	Res., 12K, ±1%, 1/4W, Metal	DRE138141
R1359	Res., 18K, ±1%, 1/4W, Metal	DRE138181
R1360	Same as R1359	
R1361	Res., 5.6K, ±1%, 1/4W, Metal	DRE138061
R1362	Same as R1361	
R1363	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1365	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1366	Res., 150, ±5%, 1/4W, Carbon	DRD137441
R1367	Same as R1366	
R1368	Res., 18K, ±5%, 1/4W, Carbon	DRD137941
R1372	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R1373 to R1376	Same as R1372	
RA1301	Resistors array, 4.7K, ±5%, 1/5W, Metal	DFB016151
RA1302	Resistors array, 10K, ±5%, 1/4W, Metal	DFB015541
D1301	LED, TLG206	DDD071121
D1302	LED, TLR206	DDD070181
D1303	Diode, 1SS 120 TA21R	DDD019071
D1304 to D1307	Same as D1303	
D1308	Diode, 1K34A	DDD010101
D1309	Same as D1308	
D1352	Diode, 1SS 120 TA21R	DDD019071
D1353 to D1358	Same as D1352	
D1359	Diode ISS97	DDD010451
Q1301	Transistor, 2SC 1815GR TPER1	DTR139011
Q1351	Transistor, 2SA 1015Y TPER1	DTR119011
Q1352, Q1353	Same as Q1351	
IC1301	IC., SN 7406N	DIC110071
IC1302	IC., MC 74HC10N	DIC440111
IC1303	Same as IC1302	
IC1304	IC., HA 17012PB	DIC641901
IC1305	IC., NJM 4558D	DIC613031

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
IC1311	IC., MC 74HC04N	DIC440051
IC1312	IC., MC 74HC05N	DIC440061
IC1313	IC., MC 74HC10N	DIC440111
IC1314	IC., SN 74LS112N	DIC141111
IC1315	IC., MC 74HC00N	DIC440011
S1301	Switch, KSE3-6-7.5 MLDP	DSW014381
S1302	Switch, SUJ45A	DSW014721
J1311	Connector, ZC-120	DCN032781
J1301	Connector, ZC-020	DCN032701
FL1301	Flat cable, SMCD-20x80-ADx10(2.7)P1.25	KHB087911

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C1401	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1402, C1404	Same as C1401	
C1407	Same as C1401	
C1408	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1409 to C1411	Same as C1408	
C1416	Cap., 0.047μ, ±0.5%, 200V, Film	DCF160291
C1417	Same as C1416	
C1418	Cap., 1p, ±0.25%, 50V, Cer.	DCC259101
C1419	Cap., 8p, Var., 25V, Cer.	DCV019761
C1420	Same as C1408	
C1421, C1422	Same as C1416	
C1423	Same as C1418	
C1424	Same as C1419	
C1425	Cap., 33p, ±5%, 50V, Cer.	DCC239011
C1428	Same as C1408	
C1429	Same as C1401	
C1430	Cap., 1p, ±0.25p, 500V, Cer.	DCC250301
C1431	Same as C1430	
C1432	Same as C1408	
R1401	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1402	Same as R1401	
R1403	Res., 22K, ±5%, 1/4W, Carbon	DRD137781
R1404	Same as R1403	
R1405	Res., 6.8K, ±1%, 1/4W, Metal	DRE138081
R1406	Res., 3.3K, ±1%, 1/4W, Metal	DRE138001
R1407	Same as R1401	
R1408	Res., 9.1K, ±1%, 1/4W, Metal	DRE138111
R1409	Res., 15K, ±1%, 1/4W, Metal	DRE138161
R1410	Same as R1405	
R1411 to R1412	Same as R1403	
R1413	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R1414	Res., 68K, ±5%, 1/4W, Carbon	DRD138081
R1415	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R1416	Same as R1415	
R1419	Res., 100, Var., 0.3W, Metal glazed	DRV412121
R1420	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R1421	Thermistor, 112102-2	DDD080421
R1422	Res., 120, ±1%, 1/4W, Metal	DRE137661
R1423	Res., 1K, Var., 0.3W, Metal glazed	DRV412081
R1424	Res., 1.5K, ±1%, 1/4W, Metal	DRE137921
R1425	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R1426	Same as R1425	
R1427	Res., 22K, ±1%, 1/4W, Metal	DRE138021
R1428	Same as R1403	
R1429	Res., 120K, ±5%, 1/4W, Carbon	DRD138141
R1430	Res., 39K, ±5%, 1/4W, Carbon	DRD138021
R1431	Res., 33K, ±1%, 1/4W, Metal	DRE138241
R1432	Thermistor, 112103-2	DDD080431
R1434	Res., 5.1K, ±1%, 1/4W, Metal	DRE138051
R1435	Same as R1434	
R1436	Res., 270, ±1%, 1/4W, Metal	DRE137741
R1437	Same as R1436	
R1439	Res., 470, ±1%, 1/4W, Metal	DRE137801
R1440	Same as R1439	
R1441	Res., 510, ±1%, 1/4W, Metal	DRE137811
R1442	Res., 510, ±5%, 1/4W, Carbon	DRD137571
R1443	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R1444	Res., 1.8K, ±5%, 1/4W, Carbon	DRD137701
R1445	Res., 56K, ±5%, 1/4W, Carbon	DRD138061
R1446	Res., 2.7K, ±5%, 1/4W, Carbon	DRD137741
R1447	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R1448	Res., 47K, ±1%, 1/2W, Metal	DRE141231
R1449	Res., 390, ±5%, 1/4W, Carbon	DRD137541
R1450	Res., 22K, ±1%, 1/4W, Metal	DRE138201
R1451	Same as R1450	
R1452	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R1453	Res., 500, Var., 0.3W, Metal glazed	DRV412071
R1454	Same as R1452	
R1455	Same as R1445	
R1456	Same as R1446	
R1457	Same as R1447	
R1458	Same as R1443	
R1459	Same as R1444	
R1460	Same as R1448	
R1461	Res., 47, ±5%, 1/4W, Carbon	DRD137321
R1462 to R1463	Same as R1450	
R1466	Res., 10K, Var., 0.3W, Metal glazed	DRV412151
R1467	Res., 47K, ±5%, 1/4W, Metal	DRE138281
R1468	Same as R1420	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R1470	Same as R1434	
R1471	Same as R1420	
R1473	Res., 43K, ±5%, 1/4W, Carbon	DRD138031
R1474	Res., 3.0K, ±1%, 1/4W, Metal	DRE137991
R1475	Same as R1419	
R1476	Same as R1474	
R1477	Res., 360, ±1%, 1/4W, Metal	DRE137771
R1478	Same as R1443	
R1479, R1480	Same as R1424	
R1481	Res., 4.3K, ±5%, 1/4W, Carbon	DRD137791
R1482	Res., 1.6K, ±5%, 1/4W, Carbon	DRD137691
R1483	Res., 5.1K, ±5%, 1/4W, Carbon	DRD137811
R1484	Res., 1.1K, ±5%, 1/4W, Carbon	DRD137651
R1485	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1486	Same as R1485	
R1487	Same as R1401	
R1488	Same as R1413	
R1489	Res., 7.5K, ±1%, 1/4W, Metal	DRE138091
R1490	Res., 5K, Var., 0.3W, Metal glazed	DRV412091
R1491	Same as R1413	
R1492	Same as R1443	
R1493	Res., 8.2K, ±1%, 1/4W, Metal	DRE138101
R1494	Res., 100, ±5%, 1/4W, Carbon	DRD137401
RA1412	Resistors array, 47K, ±5%, 1/6W, Metal	DFB016271
D1401	Diode, 1SS 120 TA21R	DDD019071
D1402 to D1404	Same as D1401	
D1405	Diode, 1K34A	DDD010101
D1406	Same as D1401	
D1408	Diode, 1SS 97	DDD010451
D1409	Same as D1408	
Q1401	Transistor, 2SC 3064	DTR135871
Q1404	Transistor, 2SA 1206 TRC	DTR119041
Q1405	Same as Q1404	
Q1406	Transistor, 2SA 1015Y TPER1	DTR119011
Q1407	Transistor, 2SC 1815GR TPER1	DTR139011
Q1408, Q1409	Same as Q1406	
Q1410, Q1411	Same as Q1404	
Q1412, Q1413	Same as Q1407	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Q1414	Transistor, 2SC 1907 TR	DTR139061
Q1415	Transistor, 2SA 899G/B	DTR115691
Q1416	Transistor, 2SC 1904G/B	DTR137051
Q1417	Same as Q1414	
Q1418	Same as Q1415	
Q1419	Same as Q1416	
Q1420	Same as Q1401	
Q1422, Q1423	Same as Q1406	
Q1424, Q1425	Same as Q1404	
Q1426 to Q1428	Same as Q1406	
Q1429	Same as Q1407	
IC1401	IC., SN 7406N	DIC110071
IC1402	IC., MC 74HC02N	DIC440031
RL1401	Relay, MZ-12HS	DKD026501
P1401	Connector, M36-04-30-114P	DCN034871
P1403	Connector, M36-02-30-114P	DCN034851
P1412	Same as P141401	
J1401	Connector, M36M87-04	DCN034621
J1403	Connector, M36M87-02	DCN034601
J1412	Same as J141401	
	Socket contact	DCN034951

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C1502	Cap., 0.1μ, −20 ~ +80%, 50V, Cer.	DCC137091
C1503	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1504	Same as C1503	
C1506	Cap., 5p, ±0.25p, 500V, Cer.	DCC250101
C1507	Cap., 0.022μ, ±10%, 200V, Film	DCF150271
C1508	Cap., 0.047μ, ±10%, 200V, Film	DCF150311
C1510	Same as C1503	
C1511	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1512, C1513	Same as C1511	
R1501	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R1502	Same as R1501	
R1503	Res., 68K, ±5%, 1/6W, Carbon	DRD198081
R1504	Same as R1501	
R1505	Res., 16K, ±5%, 1/4W, Carbon	DRD137931
R1506	Res., 5.6K, ±5%, 1/4W, Carbon	DRD137821
R1507	Res., 1.8K, ±5%, 1/4W, Carbon	DRD137701
R1508	Same as R1501	
R1509	Res., 33K, ±5%, 1/4W, Carbon	DRD138001
R1510	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1511	Res., 3.6K, ±5%, 1/4W, Carbon	DRD137771
R1512	Res., 12K, ±5%, 1/4W, Carbon	DRD137901
R1513	Same as R1503	
R1514	Same as R1501	
R1515	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R1516	Res., 2.4K, ±5%, 1/4W, Carbon	DRD137731
R1517	Res., 7.5K, ±5%, 1/4W, Carbon	DRD137851
R1519	Same as R1516	
R1520	Same as R1517	
R1521	Same as R1506	
R1522	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R1524	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R1525	Same as R1506	
R1526	Res., 2.0K, ±5%, 1/4W, Carbon	DRD137711
R1527	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1528	Same as R1516	
R1529	Res., 220K, ±5%, 1/4W, Carbon	DRD138201
R1531	Res., 1.2K, ±5%, 1/4W, Carbon	DRD137661
R1532	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R1533	Res., 39K, ±1%, 1/4W, Metal	DRE138261
R1534	Res., 27K, ±1%, 1/4W, Metal	DRE138221
R1535	Res., 180K, ±1%, 1/4W, Metal	DRE137461
R1536	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1537	Res., 3.3K, ±1%, 1/4W, Metal	DRE138001
R1538	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R1539	Res., 68K, ±1%, 1/4W, Metal	DRE138321
R1541	Same as R1537	
R1542, R1543	Same as R1510	
R1544	Res., 4.3K, ±5%, 1/4W, Carbon	DRD137791
R1545	Same as R1505	
R1546	Same as R1538	
R1547	Res., 16K, ±5%, 1/4W, Carbon	DRD137931
R1548	Res., 11K, ±5%, 1/4W, Carbon	DRD137891
D1501	Diode, 1SS 120 TA21R	DDD019071
D1502 to D1522	Same as D1501	
D1523	Diode, RD5.6EB1 TA21R	DDD031141
D1524	Same as D1519	
Q1501	Transistor, 2SC 1815GR TPER1	DTR139011
Q1502 to Q1508	Same as Q1501	
Q1509	Transistor, 2SD 668AC	DTR145381
Q1510	Transistor, 2SB 648AC	DTR125191
IC1501	IC., MC 74HC05N	DIC440061
J1501	Connector, M31M87-08	DCN034511
J1502	Connector, M36-02-30-114P	DCN034851
J1510	Connector, BNC 234	DCN040731
J1402	Connector, ZC-120	DCN032781
P1501	Connector, M33-08-30-114P	DCN034701
P1502	Connector, M36-02-30-114P	DCN034851
FL151402	Flat cable SMCD-20x80-ADx10(2.7)P1.25	KHB087911

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C1601	Cap., 22μ, ±20%, 25V, Elect.	DCE229211
C1603	Cap., 0.22μ, ±10%, 50V, Film	DCF121481
C1604	Same as C1603	
C1605	Cap., 1000p, ±10%, 50V, Cer.	DCC159011
C1606	Cap., 4700p, ±10%, 500V, Cer.	DCC152901
C1607	Cap., 1000p, ±20%, 3KV, Cer.	DCC171831
C1608	Cap., 0.01μ, −20 ~ +80%, 3KV, Cer.	DCC173501
C1609 to C1612	Same as C1208	
C1613	Same as C1207	
C1614	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1615 to C1623	Same as C1205	
R1601	Res., 560, ±5%, 1/4W, Carbon	DRD137581
R1602	Same as R1601	
R1603	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R1604	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1605	Same as R1604	
R1606	R 22K, ±5%, 1/4W, Carbon	DRD137961
R1607	Res., 680, ±5%, 1/4W, Carbon	DRD137601
R1608	Res., 22K, VAR., 0.2W, Metal	DRV430701
R1609	Res., 47K, ±1%, 1/4W, Metal	DRE138281
R1611	Res., 100K, VAR., 0.2W, Metal	DRV430631
R1612	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R1613	Res., 1.0M, ±5%, 1/4W, Carbon	DRD138361
R1614	Res., 18K, ±5%, 1/4W, Carbon	DRD137941
R1615	Res., 22M, ±5%, 1/2W, Metal	DRG940341
R1616	Res., 10, ±5%, 1/4W, Carbon	DRD137161
R1617	Res., 5.6M, ±5%, 1/2W, Metal	DRG940361
R1618	Res., 12M, ±5%, 1/2W, Metal	DRG950151
R1619	Res., 620K, ±1%, 1/4W, Metal	DRE138551
R1621	Res., 220K, VAR., 0.2W, Metal	DRV430611
R1623	Same as R1621	
R1624	Res., 33K, ±5%, 1/4W, Carbon	DRD138001
R1625	Same as R1624	
R1631	Same as R1603	
R1632	Res., 2M, VAR., 1W, Metal	DRV350331
D1601	Diode, 1SS 120 TA21R	DDD019071
D1602	Same as D1601	
D1603	Diode, ESJA35-12	DDD022111
D1604 to D1608	Same as D1603	
Q1601	Transistor, 2SC 2502	DTR137571
Q1602	Transistor, 2SA 1015Y TPER	DTR119011
IC1601	IC., NJM 4558D	DIC613031
P1601	Connector, M36-02-30-114P	DCN034851
P1602	Connector, M36-06-30-114P	DCN034891
P1603	Connector, M36-03-30-114P	DCN034861
P1604	Connector, M36-03-30-134P	DCN034911
P1630	Connector, M36-04-30-134P	DCN034921
J1601	Connector, M36M87-02	DCN034601
J1602	Connector, M36M87-06	DCN034641
J1603	Connector, M36M87-03	DCN034611
J1604	Same as J161603	
J1630	Connector, M36M87-04	DCN034621
L1601	Orthogonality coil	DLC140251
T1601	High voltage transformer	DCL220371
V1601	CRT E8357B31	DET014171
M1601	High voltage block MR4A-12F	DES050601
NE1601	Neon lamp NL-235D	DLP025171
SK1601	CRT socket S-B0864	DSK010291

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612		
C1701	Cap., 100p, ±20%, 16V, Elect.	DCE225041
C1702	Cap., 0.1μ, ±10%, 50V, Film	DCF121441
C1703	Same as C1702	
C1704	Cap., 10000μ, ±20%, 16V, Elect.	DCE920781
C1706	Same as C1701	
C1710	Cap., 470p, ±20%, 100V, Elect.	DCE253221
C1711	Cap., 10p, −10 ~ 150%, 160V, Elect.	DCE160501
C1712	Cap., 0.022μ, ±10%, 200V, Film	DCF150271
C1713	Same as C1710	
C1714	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1715	Same as C1714	
C1716	Cap., 33μ, ±20%, 100V, Elect.	DCE253171
C1717	Cap., 4700p, ±20%, 25V, Elect.	DCE223181
C1718	Same as C1717	
C1719	Cap., 100μ, ±20%, 25V, Elect.	DCE229211
C1720	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1721	Same as C1714	
C1722	Same as C1719	
C1723	Same as C1720	
C1724	Same as C1714	
C1725	Same as C1719	
C1726	Cap., 4700p, ±20%, 16V, Elect.	DCE223161
C1727	Cap., 47μ, ±20%, 10V, Elect.	DCE215301
C1728	Cap., 0.047μ, ±10%, 50V, Film	DCF121401
C1729	Cap., 10p, ±0.5%, 6.3V, Elect.	DCE910071
C1730	Cap., 680p, ±10%, 50V, Cer.	DCC139371
C1731	Same as C1720	
R1701	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R1711	Res., 220K, ±5%, 1/4W, Carbon	DRD138201
R1712	Res., 10K, ±5%, 1W, Metal	DRS220551
R1713	Res., 150, ±5%, 1/4W, Carbon	DRD137441
R1714	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R1715	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R1717	Same as R1715	
R1719	Res., 2.2, ±5%, 1W, Metal	DRS220111
R1720	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R1721	Same as R1715	
R1722	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1723	Same as R1715	
R1724	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R1725	Same as R1724	
R1726	Res., 5.6K, ±5%, 1W, Metal	DRS220521
R1727	Res., 1.2, ±5%, 1W, Metal	DRS220801
R1728	Same as R1727	
R1729, R1730	Same as R1715	
R1731	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R1732	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R1733, R1734	Same as R1727	
R1735	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R1736	Same as R1731	
R1737	Res., 1K, Var., 1/2W, Metal	DRV430571
R1738	Same as R1731	
R1739	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R1740	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R1741	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R1742	Same as R1711	
R1744	Same as R1732	
D1701	Stacked rectifier S5VB10	DDD021171
D1711	Diode, S4VB10	DDD023311
D1712	Diode, 1D4B1	DDD021021
D1713	Same as D1712	
D1714	Diode, S2VB10	DDD022831
D1715	Diode, RD24ESB/HZS24NB TA21R	DDD038861
D1716	Same as D1715	
D1717	Diode, 1SS 120 TA21R	DDD019071
D1718	Diode, V06E	DDD020091
D1719, D1720	Same as D1715	
D1721	Same as D1717	
D1722	Same as D1718	
D1723	Diode, RD8.2EB1 TA21R	DDD030881
D1724	Same as D1717	
D1725	Diode, RD5.1EB2 TA21R	DDD032071
D1726	Same as D1723	
Q1710	Transistor, 2SC 1904G/B	DTR137051
Q1711	Transistor, 2SB 861C	DTR125181
Q1712	Transistor, 2SD 1137	DTR145711

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Q1713	Transistor, 2SC 1815GR TPER1	DTR139011
Q1714	Transistor, 2SD 1266P	DTR145831
Q1715	Same as Q1713	
Q1716	Transistor, 2SK 30ATM-0 TPER1	DTR219011
Q1717	Transistor, 2SA 1015Y TPER1	DTR119011
Q1718	Transistor, 2SB 941P/Q	DTR125451
Q1719	Same as Q1717	
IC1701	IC., STR 9005	DIC652881
IC1702	IC., μ-PC 14312H	DIC650031
IC1703	IC., LM 2940CT-5.0	DIC653081
IC1704	IC., μ-PC 16305H	DIC650111
IC1711	IC., NJM 4558D	DIC613031
IC1712	Same as IC1711	
S1701	Switch, SDGA3P-B	DSW016541
J1702	Power source selector jock S-17220 #04	DCN093521
J1704	Connector, 128-03-10-281S	DCN032031
J1706	Connector, M36M87-02	DCN034601
J1707	Same as J1706	
J1713	Connector, M31M87-10	DCN034531
J1721	Connector, M36M87-03	DCN034611
J1722	Connector, M36M87-04	DCN034621
J1723	Connector, M36M87-05	DCN034631
J1725	Connector, M36M87-02	DCN034601
J1731	Connector, M31M87-12	DCN034541
J1732 to J1733	Same as J1721	
P1701	Noise Filtor, GL-2030E	DHF031841
P1702	Power source selector plug X-17213	DCN093511
P1704	Connector, 128-03-10-281P	DCN032011
P1706	Connector, M36-02-30-114P	DCN034851
P1707	Same as P1706	
P1713	Connector, M33-10-30-114P	DCN034721
P1721	Connector, M36-03-30-114P	DCN034861
P1722	Connector, M36-04-30-114P	DCN034871
P1723	Connector, M36-05-30-114P	DCN034881
P1725	Connector, M36-02-30-114P	DCN034851
P1731	Connector, M33-12-30-114P	DCN034731
P1732, P1733	Same as J1721	
T1701	Transformer, FS 36965-5	DCL213512
F1702	Fuse, FSA-2	DFU020151
F1702	Fuse Holder, FH033	DSK065361
F1701	Fuse, FSB-1	DFU021031
F1711	Fuse Holder, S-N5051	DSK060151
M1701	FAN Motor, MMF-06B 12DH-R	DMT620161
TB1701	8ϕ ground terminal	DTA020501

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6411		
C1701	Cap., 100p, ±20%, 16V, Elect.	DCE225041
C1702	Cap., 0.1μ, ±10%, 50V, Film	DCF121441
C1703	Same as C1702	
C1704	Cap., 1000p, ±20%, 16V, Elect.	DCE920781
C1706	Same as C1701	
C1710	Cap., 470p, ±20%, 100V, Elect.	DCE253221
C1711	Cap., 10μ, −10 ~ 150%, 160V, Elect.	DCE160501
C1712	Cap., 0.022μ, ±10%, 200V, Film	DCF150271
C1713	Same as C1710	
C1714	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1715	Same as C1714	
C1716	Cap., 33μ, ±20%, 100V, Elect.	DCE253171
C1717	Cap., 4700p, ±20%, 25V, Elect.	DCE223281
C1718	Same as C1717	
C1719	Cap., 100μ,±20%, 25V, Elect.	DCE229211
C1720	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C1721	Same as C1714	
C1722	Same as C1719	
C1723	Same as C1720	
C1724	Same as C1714	
C1725	Same as C1719	
C1726	Cap., 4700p, ±20%, 16V, Elect.	DCE223161
C1727	Cap., 47μ, ±20%, 10V, Elect.	DCE215301
C1728	Cap., 0.047μ, ±10%, 50V, Film	DCF121401
C1729	Cap., 10μ, ±20%, 6.3V, Elect.	DCE910071
C1730	Cap., 680p, ±10%, 50V, Cer.	DCC139371
C1731	Same as C1720	
R1701	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R1711	Res., 220K, ±5%, 1/4W, Carbon	DRD138201
R1712	Res., 10K, ±5%, 1W, Metal	DRS220551
R1713	Res., 150, ±5%, 1/4W, Carbon	DRD137441
R1714	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R1715	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R1717	Same as R1715	
R1719	Res., 2.2, ±5%, 1W, Metal	DRS220111
R1720	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R1721	Same as R1715	
R1722	Res., 100K, ±1%, 1/4W, Metal	DRE138361
R1723	Same as R1715	
R1724	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R1725	Same as R1724	
R1726	Res., 5.6K, ±5%, 1W, Metal	DRS220521
R1727	Res., 1.2, ±5%, 1W, Metal	DRS220801
R1728	Same as R1727	
R1729, R1730	Same as R1715	
R1731	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R1732	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R1733, R1734	Same as R1727	
R1735	Res., 10K, ±1%, 1/4W, Metal	DRE137881
R1736	Same as R1731	
R1737	Res., 1K, Var., 1/2W, Cermet	DRV430571
R1738	Same as R1731	
R1739	Res., 20K, ±5%, 1/4W, Carbon	DRD137951
R1740	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R1741	Res., 22K, ±5%, 1/4W, Carbon	DRD137961
R1742	Same as R1711	
R1744	Same as R1732	
D1701	Rectifier Diode, S5VB10	DDD021171
D1711	Diode, S4VB10	DDD023311
D1712	Diode, 1D4B1	DDD021021
D1713	Same as D1712	
D1714	Diode, S2VB10	DDD022831
D1715	Diode, RD24ESB/HZS24NB TA21R	DDD038861
D1716	Same as D1715	
D1717	Diode, 1SS 120 TA21R	DDD019071
D1718	Diode, V06E	DDD020091
D1719, D1720	Same as D1715	
D1721	Same as D1717	
D1722	Same as D1718	
D1723	Diode, RD8.2EB1 TA21R	DDD030881
D1724	Same as D1717	
D1725	Diode, RD5.1EB2 TA21R	DDD032071
D1726	Same as D1723	
Q1710	Transistor, 2SC 1904G/B	DTR137051
Q1711	Transistor, 2SB 861C	DTR125181
Q1712	Transistor, 2SD 1137	DTR145711

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Q1713	Transistor, 2SC 1815GR TPER1	DTR139011
Q1714	Transistor, 2SD 1266P	DTR145831
Q1715	Same as Q1713	
Q1716	Transistor, 2SK 30ATM-0 TPER1	DTR219011
Q1717	Transistor, 2SA 1015Y TPER1	DTR119011
Q1718	Transistor, 2SB 941P/Q	DTR125451
Q1719	Same as Q1717	
S1701	Switch, SDGA3P-B	DSW016541
IC1701	IC., STR 9005	DIC652881
IC1702	IC., μ-PC 14312H	DIC650031
IC1703	IC., LM 2940CT-5.0 (NS)	DIC653081
IC1711	IC., NJM 4558D	DIC613031
IC1712	Same as IC1711	
J1702	Connector Line Voltage range plug, X-17213	DCN093511
J1704	Connector, 128-03-10-281S	DCN032031
J1706	Connector, M36M87-02	DCN034601
J1707	Same as J1706	
J1713	Connector, M31M87-12	DCN034541
J1721	Connector, M36M87-03	DCN034611
J1722	Connector, M36M87-04	DCN034621
J1723	Same as J1722	
J1725	Connector, M36M87-02	DCN034601
J1731	Same as J1713	
J1732	Same as J1721	
P1701	Noise Filtor, GL-2030E	DHF031841
P1702	Connector, Line Voltage range Socket, S-17220 #04	DCN093521
P1704	Connector, 128-03-10-281	DCN032011
P1706	Connector, M36-02-30-114P	DCN034851
P1707	Same as P1706	
P1713	Connector, M33-12-30-114P	DCN034731
P1721	Connector, M36-03-30-114P	DCN034861
P1722	Connector, M36-04-30-114P	DCN034871
P1723	Same as P1722	
P1725	Connector, M36-02-30-114P	DCN034851
P1731	Same as P1713	
P1732	Same as P1721	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
T1701	Transformer, Power, FS-36965-5	DCL213512
F1702	Fuse, FSA-2	DFU020151
F1701	Fuse, FSB-1	DFU021031
F1711	Fuse Holder, S-N5051	DSK060151
M1701	Fan Motor, MMF-06B12DH-R	DMT620161
TB1701	8ϕ ground terminal	DTA020501

POS 18

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C1801	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C1802 to C1803	Same as C1801	
R1801	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1802	Same as R1801	
R1803	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R1804	Same as R1803	
R1805	Res., 10K, VAR., 0.125W, Carbon	DRV145771
R1806	Same as R1805	
R1807	Res., 5.1K, ±5%, 1/4W, Carbon	DRD137811
R1808	Res., 6.2K, ±5%, 1/4W, Carbon	DRD137831
R1811	Res., 2.0K, ±5%, 1/4W, Carbon	DRD137711
R1812	Same as R1811	
R1813	Res., 9.1K, ±5%, 1/4W, Carbon	DRD137871
R1814	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R1815	Res., 3.0K, ±5%, 1/4W, Carbon	DRD137751
R1816	Same as R1814	
R1817	Same as R1811	
R1818	Res., 8.2K, ±5%, 1/4W, Carbon	DRD137861
R1819	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R1820 to R1821	Same as R1805	
D1801	Diode, 1SS 120 TA21R	DDD019071
D1802	Same as D1801	
D1804	LED, TLR206	DDD070181
Q1801	Transistor, 2SC 1815GR TPER1	DTR139011
Q1802	Same as Q1801	
S1803	Switch, SUJ12A	DSW014831
P1801	Connector, M33-15-30-114P	DCN034741
P1802	Connector, M33-07-30-114P	DCN034691
P1803	Connector, M36-05-30-134P	DCN034931
J1801	Connector, M31M87-15	DCN034551
J1802	Connector, M31M87-07	DCN034501
J1803	Connector, M36M87-05	DCN034631

VR 19

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C1910	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
R1901	Res., 50K, VAR., 0.125W, Carbon	DRV146842
R1902	Same as R1901	
R1903	Res., 4.7, ±5%, 2W, Metal	DRS231121
R1904	Res., 50, VAR., 1.5W, Metal	DRV350301
R1905	Res., 50, ±5%, 1W, Metal	DRS220331
R1906	Res., 20K, VAR., 0.125W, Carbon	DRV146961
R1908	Res., 10K, VAR., 0.1W, Carbon	DRV147511
R1909	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1910	Res., 3.0K, ±5%, 1/4W, Carbon	DRD137751
R1911	Same as R1908	
R1912	Res., 5.6K, ±5%, 1/4W, Carbon	DRD137821
R1913	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R1914	Res., 3.9K, ±5%, 1/4W, Carbon	DRD137781
R1915	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R1916	Res., 330, ±5%, 1/4W, Carbon	DRD137521
R1917	Res., 1.5K, ±5%, 1/4W, Carbon	DRD137681
R1918	Res., 20K, VAR., 0.125W, Carbon	DRV146981
D1901	Diode, 1SS 120 TA21R	DDD019071
D1902	LED, TLG144	DDD071911
Q1901	Transistor, 2SC 1815GR TPER1	DTR139011
Q1902	Transistor, 2SA 1015Y TPER1	DTR119011
Q1903 to Q1094	Same as Q1902	
Q1905	Same as Q1901	
P1902	Connector, M36M87-06	DCN034641
J1901	Connector, ZC-120	DCN032781
J1902	Connector, M36M87-06	DCN034641
PL1901	Lamp, BQ064-22012A	DLP016092
PL1902, PL1903	Same as PL1901	

V I/O 20

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C2001	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C2002 to C2008	Same as C2001	
R2001	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R2002	Res., 47K, ±5%, 1/4W, Carbon	DRD138041
R2003, R2004	Same as R2001	
R2005	Same as R2002	
R2006	Same as R2001	
R2007 to R2009	Same as R2002	
R2010	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R2011	Same as R2010	
R2012	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R2013 to R2019	Same as R2012	
RA2001	Resistors array, 4.7K, ±5%, 1/8W, Metal	DFB015791
RA2002	Same as 20RA01	
D2001	Diode, 1SS 120 TA21R	DDD019071
D2002 toD2006	Same as D2001	
Q2001	Transistor, DTC 114-A	DTR190941
Q2002	Same as Q2001	
IC2001	IC., CD026AP	DIC492891
IC2002, IC2003	Same as IC2001	
J2001	Connector, ZC-110	DCN032731
J2002	Connector, ZC-116	DCN032761
J2003	Connector, M31M87-10	DCN034531
P2003	Connector, M33-10-30-114P	DCN034721
FL2001	Flat cable SMCD-10X300-BDX10(2.7) P1.25	KHB088211

H I/O 21

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612		
C2101	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C2102 to C2105	Same as C2101	
RL2101	Relay, SY-12	DKD027301
RL2102	Same as RL2101	
R2101	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R2102	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R2105	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R2106	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R2108	Same as R2105	
RA2101	Resistors array, 100K, ±5%, 1/4W, Metal	DFB016141
D2101	Diode, 1SS 120 TA21R	DDD019071
D2102, D2103	Same as D2101	
Q2101	Transistor, DTC114-A	DTR190941
Q2102	Same as Q2101	
Q2103	Transistor, 2SC 1815GR TPER1	DTR139011
Q2104	Same as Q2103	
IC2103	IC., CD026AP	DIC492891
IC2104 to IC2107	Same as IC2103	
IC2108	IC., MC 74HC00N	DIC440011
IC2109	IC., MC 74HC7266N	DIC492991
RL2101	Relay SY-12	DKD027301
RL2102	Same as RL2101	
P2102	Connector, M33-15-30-134P	DCN034841
P2105	Connector, M36-04-30-134P	DCN034921
J2101	Connector, ZC-116	DCN032761
J2102	Connector, M31M87-15	DCN034551
J2103	Connector, ZC-016	DCN032681
J2104	Connector, ZC-110	DCN032731
FL2101	Flat cable SMCD-16X120-ADX10(2.7) P1.25	KHB088111

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6411		
C2101	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C2102 to C2105	Same as C2101	
RL2101	Relay, SY-12	DKD027301
RL2102	Same as RL2101	
R2101	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R2102	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R2105	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R2106	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R2107	Same as R2102	
R2108	Same as R2105	
RA2101	Resistors array, 100K, ±5%, 1/4W, Metal	DFB016141
D2102	Diode, 1SS 120 TA21R	DDD019071
D2103	Same as D2102	
Q2101	Transistor, DTC 114-A	DTR190941
Q2102	Same as Q2101	
Q2103	Transistor, 2SC 1815GR TPER1	DTR139011
Q2104	Same as Q2103	
IC2103	IC., CD026AP	DIC492891
IC2104 to IC2107	Same as IC2103	
IC2108	IC., MC 74HC00N	DIC440011
IC2109	IC., MC 74HC7266N	DIC492991
RL2102	Relay SY-12	DKD027301
P2102	Connector, M33-15-30-134P	DCN034841
P2105	Connector, M36-04-30-134P	DCN034921
J2101	Connector, ZC-116	DCN032761
J2102	Connector, M31M87-15	DCN034551
J2103	Connector, ZC-016	DCN032681
J2104	Connector, ZC-110	DCN032731

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
FL2101	Flat cable SMCD-16X120-ADX10 (2.7)P1.25	KHB088111

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C3003	Cap., 10p, ±0.5%, 50V, Cer.	DCC239041
C3004	Cap., 2200p, ±10%, 50V, Film	DCF121241
C3006	Cap., 56p, ±5%, 50V, Cer.	DCC239251
R3001	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R3002	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R3003	Same as R3001	
R3006	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
RA3001	Resistors array, 100K, ±5%, 1/8W, Metal	DFB015661
D3002	Diode, 1SS120 TA21R	DDD019071
J3001	Connector, ZC-140	DCN032801
IC301A	IC., MC 74HC 157N	DIC441581
IC301C	IC., MC 74HC 02N	DIC440031
IC301D	IC., MC 74HC 123AN	DIC441241
IC301E	Same as IC301C	
IC301F	IC., MC 74HC 74N	DIC440751
IC301G	IC., MC 74HC 04N	DIC440051
IC301H	Same as IC301A	
IC301J	Same as IC301A	
IC301K	IC., MC 74HC 164N	DIC441651
IC301L	IC., MC 74HC 32N	DIC440331
IC301M	IC., MC 74HC 390N	DIC443911
IC302A	Same as IC301A	
IC302B	IC., MC 74HC 151N	DIC441521
IC302D	IC., MC 74HC 393N	DIC443941
IC302E	Same as IC302D	
IC302F	Same as IC301F	
IC302G	Same as IC301L	
IC302H	Same as IC301F	
IC302J	Same as IC301F	
IC302K	Same as IC301L	
IC302L	IC., MC 74HC00N	DIC440011
IC303B	IC., MC 74HC574N	DIC445751
IC303C, IC303D	Same as IC303B	
IC303F	IC., MC 74HC139N	DIC441401
IC303G	IC., HD 74HCT564P	DIC493641
IC303L	IC., MC 74HC244N	DIC442451
IC304B	Same as IC303B	
IC304C	IC., MB 8464A-10LL-SK	DIC515851
IC305C, IC306C	Same as IC303B	
IC306F	Same as IC303L	

CHA-B 31

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C3101	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C3102	Same as C3101	
C3105	Cap., 100p, ±5%, 50V, Cer.	DCC239051
R3104	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
D3101	Diode, 1SS 120 TA21R	DDD019071
IC311B	IC., MC 74HC08N	DIC440091
IC312C	IC., MC 74HC32N	DIC440331
IC313E	IC., HM 6147P	DIC515321
IC313H	IC., μ-PD 71054C	DIC555861
IC314H	IC., MB 61VH138A	DIC492552
IC316J	IC., MB 8464A-10LL-SK	DIC515851
J3101	Connector, ZC-140	DCN032801
X3101	Crystal, EXO-3C	DIC555861

CHA-C 32

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C3207	Cap., 0.01μ, ±30%, 16V, Cer.	DCC929031
C3207 to C3228	Same as C3207	
C3229	Cap., 22μ, ±20%, 25V, Elect.	DCE225151

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C3302	Cap., 100p, ±5%, 50V, Cer.	DCC239051
C3304	Cap., 5p, ±0.25p, 50V, Cer.	DCC239301
C3305	Cap., 180p, ±5%, 50V, Cer.	DCC239271
C3306	Cap., 120p, ±5%, 50V, Cer.	DCC239261
C3307	Cap., 470p, ±10%, 50V, Cer.	DCC139351
C3308	Same as C3307	
C3310	Cap., 3p, ±0.25p, 50V, Cer.	DCC239071
C3312	Same as C3302	
C3313	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C3314	Same as C3302	
C3315	Same as C3307	
C3317	Cap., 15p, ±5%, 50V, Cer.	DCC239221
C3318	Cap., 47p, ±5%, 50V, Cer.	DCC239031
C3319	Same as C3302	
C3321	Cap., 22μ, ±20%, 25V, Elect.	DCE225151
C3322, C3323	Same as C3321	
C3324, C3325	Same as C3302	
R3301	Res., 12K, ±1%, 1/4W, Metal	DRE138141
R3302	Cap., 15K, ±1%, 1/4W, Carbon	DRD138161
R3303	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R3305	Res., 12K, ±5%, 1/4W, Carbon	DRD137901
R3306	Res., 4.7K, ±5%, 1/4W, Carbon	DRD137801
R3311	Res., 4.3K, ±1%, 1/4W, Metal	DRE138031
R3312	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R3313	Res., 8.2K, ±1%, 1/4W, Metal	DRE138101
R3314	Res., 300, ±1%, 1/4W, Metal	DRE137751
R3315	Same as R3305	
R3316	Same as R3306	
R3321	Res., 4.3K, ±5%, 1/4W, Carbon	DRD138031
R3324	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R3325	Same as R3306	
R3326	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R3328	Res., 1.3K, ±1%, 1/4W, Metal	DRE137911
R3329	Res., 470, ±1%, 1/4W, Metal	DRE137801
R3331	Same as R3306	
R3332	Res., 5.1K, ±1%, 1/4W, Metal	DRE138051
R3333	Same as R3303	
R3334	Res., 3.3K, ±1%, 1/4W, Metal	DRE138001
R3335	Same as R3329	
R3336	Res., 12K, ±5%, 1/4W, Carbon	DRD137901
R3337	Same as R3306	
R3340	Same as R3306	
R3341	Res., 2.2K, ±5%, 1/4W, Carbon	DRD137721
R3343	Res., 470, ±5%, 1/4W, Carbon	DRD137561
R3344	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R3345	Same as R3344	
R3346	Res., 120, ±5%, 1/4W, Carbon	DRD137421
R3351	Res., 1.0K, ±5%, 1W, Metal	DRS221271
R3352, R3353	Same as R3351	
R3360	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R3361 to R3363	Same as R3360	
D3301	Diode, 1SS 120 TA21R	DDD019071
D3302 to D3306	Same as D3301	
D3307	Diode, 1SS 97	DDD010451
D3308	Same as D3307	
Q3301	Transistor, 2SC 2037	DTR137591
Q3302	Transistor, 2SC 1815GR TPER1	DTR139011
Q3303	Same as Q3301	
Q3304	Same as Q3302	
Q3305	Same as Q3301	
Q3306, Q3307	Same as Q3302	
Q3308	Transistor, 2SA 1015Y TPER1	DTR119011
IC3301	IC., HA 17012PB	DIC641901
IC3302	Same as IC3301	
IC3303	IC., CD 4052BE	DIC410511
IC3304	IC., NJM 082D	DIC614101
IC3305	IC., TC74HC02P/HD74HC02P	DIC450031
IC3306	IC., NJM 4558D	DIC613031
IC3307	Same as IC3306	
J3301	Connector, ZC-140	DCN032801
J3302	Connector, M36M87-06	DCN034641
J3303	Connector, M36M87-04	DCN034621
J3304	Connector, M31M87-10	DCN034531
J3305	Connector, M31M87-08	DCN034511
J3306	Connector, M36M87-03	DCN034611
J3310	Connector, BNC234	DCN040731

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
J3311, J3312	Same as J3310	
P3302	Connector, M36-06-30-134P	DCN034941
P3303	Connector, M36-04-30-134P	DCN034921
P3304	Connector, M33-10-30-134P	DCN034821
P3305	Connector, M33-08-30-134P	DCN034808
P3306	Connector, M36-03-30-134P	DCN034911
FL3301	SMCD-40X50-ADX10(2.7)P1.25	KHB087711

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612		
C35100	Cap., 22p, ±5%, 50V, Cer.	DCC239121
C35103	Cap., 2p, ±0.25p, 50V, Cer.	DCC239061
C35104	Cap., 1000p, ±10%, 50V, Cer.	DCC139051
C35105	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
35C106 to 35C107	Same as 35C105	
C35109	Cap., 39p, ±5%, 50V, Cer.	DCC239131
C35112, C35113	Same as C35105	
C35115	Cap., 220p, ±5%, 50V, Cer.	DCC239171
C35116	Same as C35104	
C35117	Same as C35115	
C35118	Cap., 12p, ±5%, 50V, Cer.	DCC239321
C35119	Cap., 1000p, ±10%, 50V, Film	DCF121201
C35120	Same as C35119	
C35121	Same as C35105	
C35122	Same as C35104	
C35123	Same as C35105	
C35124	Same as C35104	
C35131	Cap., (5.5 ~ 1.5)p, Var., 250V, Cer.	DCV019722
C35132	Cap., (2 ~ 12)p, Var., 250V, Cer.	DCV019602
C35133, C35134	Same as C35104	
C35135	Cap., 10p, ±0.5p, 50V, Cer.	DCC239041
C35136	Same as C35105	
C35137	Same as C35104	
C35138	Cap., 1p, ±0.25p, 50V, Cer.	DCC239191
C35140	Cap., 68p, ±5%, 50V, Cer.	DCC239311
C35141	Same as C35115	
C35142B, C35142C	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC133571
C35143, C35145	Same as C35105	
C35146	Cap., 10μ, ±20%, 16V, Elect.	DCE229241
C35147, C35148	Same as C35105	
C35151	Same as C35146	
C35152	Same as C35105	
C35200	Same as C35100	
C35203	Same as C35103	
C35204	Same as C35104	
C35205 to C35207	Same as C35105	
C35209	Same as C35109	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C35212, C35213	Same as C35104	
C35215	Same as C35115	
C35216	Same as C35104	
C35217	Same as C35115	
C35218	Same as C35118	
C35219, C35220	Same as C35119	
C35221	Same as C35105	
C35222	Same as C35104	
C35223	Same as C35105	
C35224	Same as C35104	
C35231	Same as C35131	
C35232	Same as C35132	
C35233, C35234	Same as C35104	
C35234	Same as C35135	
C35236	Same as C35105	
C35237	Same as C35104	
C35238	Same as C35138	
C35240	Same as C35140	
C35241	Same as C35115	
C35242	Same as C35142	
C35242B	Same as C35142B	
C35243	Same as C35105	
C35244	Cap., 0.1μ, +80 ~ −20%, 50V, Cer	DCC137091
C35245	Same as C35105	
C35246	Same as C35146	
C35247, C35248	Same as C35105	
C35250	Same as C35146	
C35251	Same as C35105	
C35301	Cap., 100μ, ±25%, 16V, Elect.	DCE225351
C35302	Same as C35105	
C35303	Same as C35301	
C35304	Same as C35105	
C35305	Same as C35301	
C35306	Same as C35105	
C35307	Same as C35301	
C35308	Same as C35105	
C35309	Same as C35301	
C35310	Same as C35105	
C35321	Same as C35142	
C35323 to C35333	Same as C35105	
C35332B	Cap., 0.1μ, +80 ~ −20%, 50V, Cer.	DCC135231
C35334, C35335	Same as C35146	
C35336	Same as C35105	
C35339	Same as C35119	
C35340	Cap., 150p, ±5%, 50V, Cer.	DCC239021
C35341	Same as C35100	
C35342	Cap., 56p, ±5%, 50V, Cer.	DCC239251
C35343	Cap., 47p, ±5%, 50V, Cer.	DCC239031
C35344	Cap., 5p, ±0.25p, 50V, Cer.	DCC239301
C35345	Same as C35105	
R35101	Res., 39, ±1%, 1/4W, Carbon	DRD137541
R35102	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R35103	Same as R35102	
R35128	Res., 10K, Var., 1/2W, Cermet	DRV410561
R35131	Res., 820K, ±1%, 1/4W, Metal	DRE138581
R35132	Res., 100, ±1%, 1/4W, Metal	DRE137641
R35133	Same as R35132	
R35134, R35135	Same as R35102	
R35136	Res., 330, ±1%, 1/4W, Metal	DRE137761
R35137	Same as R35136	
R35138	Same as R35106	
R35104	Res., 560, ±1%, 1/4W, Metal	DRE137821
R35105	Same as R35104	
R35106	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R35107	Res., 2.2K, ±1%, 1/4W, Metal	DRE137961
R35108	Res., 130, ±1%, 1/4W, Metal	DRE137671
R35109	Res., 68, ±5%, 1/4W, Carbon	DRD137361
R35110	Res., 390, ±1%, 1/4W, Metal	DRE137781
R35111	Res., 1.8K, ±1%, 1/4W, Metal	DRE137941
R35112	Same as R35109	
R35113	Res., 1K, ±1%, 1/4W, Metal	DRV410531
R35114	Res., 18, ±1%, 1/4W, Metal	DRE137461
R35115	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R35116	Res., 3.6K, ±1%, 1/4W, Metal	DRE138011
R35117	Same as R35116	
R35118	Res., 33, ±5%, 1/4W, Carbon	DRD137281
R35119	Same as R35118	
R35120	Res., 160, ±1%, 1/4W, Metal	DRD137691
R35121	Same as R35120	
R35122	Res., 22, ±1%, 1/4W, Metal	DRE137481
R35123	Same as R35122	
R35124	Res., 620, ±1%,. 1/4W, Metal	DRE137831
R35125, R35126	Same as R35122	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R35127	Res., 1.0M, ±5%, 1/4W, Carbon	DRD138361
R35139	Same as R35107	
R35140	Same as R35108	
R35141	Same as R35109	
R35142	Same as R35110	
R35243	Same as R35111	
R35144	Same as R35141	
R35145	Res., 240, ±5%, 1/4W, Carbon	DRD137491
R35146	Same as R35115	
R35147	Same as R35116	
R35148	Same as R35117	
R35149, R35150	Same as R35118	
R35151, R35152	Same as R35120	
R35153, R35154	Same as R35122	
R35155	Res., 16, ±5%, 1/4W, Carbon	DRD137211
R35156	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R35157	Res., 2K, Var., 1/2W, Cermet	DRV410541
R35158	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R35159	Res., 5.1K, ±1%, 1/4W, Metal	DRE138051
R35160	Res., 5K, Var., 1/2W, Cermet	DRV410551
R35161	Res., 2K, ±1%, 1/4W, Metal	DRE137951
R35162	Res., 160, ±5%, 1/4W, Carbon	DRD137451
R35163	Same as R35145	
R35165	Res., 470, ±1%, 1/4W, Metal	DRE137801
R35166	Res., 8.2K, ±1%, 1/4W, Metal	DRE138101
R35167	Res., 3.3K, ±1%, 1/4W, Metal	DRE138001
R35168	Res., 240, ±1%, 1/4W, Metal	DRE137731
R35169	Res., 560, ±1%, 1/4W, Metal	DRE137821
R35170	Res., 100, ±5%, 1/4W, Carbon	DRD137401
R35172	Res., 18K, ±5%, 1/4W, Carbon	DRD137941
R35174	Res., 5.1K, ±1%, 1/4W, Metal	DRE138051
R35175	Same as R35174	
R35176	Res., 3.0K, ±1%, 1/4W, Metal	DRE137991
R35178	Res., 2.0K, ±1%, 1/4W, Metal	DRE137951
R35179	Same as R35102	
R35180	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R35181	Same as R35102	
R35182	Res., 200, ±1%, 1/4W, Metal	DRE137711
R35183	Res., 18, ±1%, 1/4W, Metal	DRE137461
R35184	Same as R35183	
R35185	Thermistor 112101-2	DDD080331
R35186	Res., 10K, ±5%, 1/4W, Carbon	DRD137881

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R35199	Res., 5.6K, ±5%, 1/4W, Carbon	DRD137101
R35201	Same as R35101	
R35202, R35203	Same as R35102	
R35204, R35205	Same as R35104	
R35206	Same as R35106	
R35207	Same as R35107	
R35208	Same as R35108	
R35209	Same as R35109	
R35210	Same as R35110	
R35211	Same as R35111	
R35212	Same as R35109	
R35213	Same as R35113	
R35214	Same as R35114	
R35215	Same as R35115	
R35216, R35217	Same as R35116	
R35218, R35219	Same as R35118	
R35220, R35221	Same as R35120	
R35222, R35223	Same as R35122	
R35224	Same as R35124	
R35225, R35226	Same as R35122	
R35228	Same as R35128	
R35231	Same as R35131	
R35232, R35233	Same as R35132	
R35234, R35235	Same as R35102	
R35236, R35237	Same as R35136	
R35238	Same as R35106	
R35239	Same as R35107	
R35240	Same as R35108	
R35241	Same as R35109	
R35242	Same as R35110	
R35243	Same as R35111	
R35244	Same as R35109	
R35245	Same as R35145	
R35246	Same as R35115	
R35247, R35248	Same as R35116	
R35249, R35250	Same as R35118	
R35251, R35252	Same as R35120	
R35253, R35254	Same as R35122	
R35255	Same as R35155	
R35256	Same as R35156	
R35257	Same as R35157	
R35258	Same as R35158	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
R35259	Same as R35159	
R35260	Same as R35160	
R35261	Same as R35161	
R35262	Same as R35162	
R35263	Same as R35145	
R35265	Same as R35165	
R35266	Same as R35166	
R35267	Same as R35167	
R35268	Same as R35168	
R35269	Same as R35169	
R35270	Same as R35170	
R35272	Same as R35172	
R35274, R35275	Same as R35174	
R35276	Same as R35176	
R35278	Same as R35178	
R35279	Same as R35102	
R35280	Same as R35180	
R35281	Same as R35102	
R35282	Same as R35182	
R35283, R35284	Same as R35183	
R35285	Same as R35185	
R35286	Same as R35186	
R35299	Same as R35199	
R35301	Res., 820, ±5%, 1/4W, Carbon	DRD137621
R35302	Res., 270, ±5%, 1/4W, Carbon	DRD137501
R35303	Res., 180, ±5%, 1/4W, Carbon	DRD137461
R35304	Res., 160, ±5%, 1/4W, Carbon	DRD137451
R35305	Res., 240, ±5%, 1/4W, Carbon	DRD137491
R35306	Same as R35304	
R35307	Same as R35305	
R35308	Same as R35304	
R35309	Same as R35305	
R35310	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R35311	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
R35313	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R35314	Res., 1.3K, ±1%, 1/4W, Metal	DRE137911
R35315	Res., 500, Var., 1/2W, Cermet	DRV410521
R35318	Res., 6.8K, ±1%, 1/4W, Metal	DRE138081
R35319	Res., 5K, Var., 1/2W, Cermet	DRV410551
R35320	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R35321	Same as R35320	
R35325	Res., 2.0K, ±1%, 1/4W, Metal	DRE137951
R35326	Res., 130, ±1%, 1/4W, Metal	DRE137671
R35327	Res., 1.2K, ±1%, 1/4W, Metal	DRE137901
R35328	Res., 330, ±1%, 1/4W, Metal	DRE137761
R35329	Res., 1.3K, ±1%, 1/4W, Metal	DRE137911
R35330	Same as R35132	
R35331	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
RA35101		
RA35102		
D35101	Diode, RD5.1ESB/HZS5.1NB TA21R	DDD038701
D35102	Diode, 1SS 120 TA21R	DDD019071
D35103	Same as D35102	
D35104	Diode, 1SS 97	DDD010451
D35105, D35107	Same as D35104	
D35108	Same as D35101	
D35109 to D35111	Same as D35102	
D35112 to D35117	Same as D35104	
D35201	Same as D35101	
D35202, D35203	Same as D35102	
D35204 to D35207	Same as D35104	
D35208	Same as D35101	
D35209	Same as D35102	
D35210, D35211	Same as D35102	
D35212 to D35217	Same as D35104	
D35301, D35302	Same as D35102	
Q35101	Transistor, 2SC 2570A	DTR137671
Q35102	Same as Q35101	
Q35103	Transistor, 2SC 1815GR TPER1	DTR139011
Q35104	Transistor, 2SC 2901	DTR135741
Q35105	Transistor, 2SA 1206 TRC	DTR119041
Q35106	Same as Q35104	
Q35107	Same as Q35105	
Q35108	Transistor, μ-PA 61AL	DTR295361
Q35109, Q35110	Same as Q35104	
Q35111	Same as Q35103	
Q35112	Same as Q35104	
Q35113	Same as Q35105	
Q35114	Same as Q35104	
Q35115	Same as Q35105	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Q35116	Transistor, 2SC 2037	DTR137591
Q35117, Q35118	Same as Q35104	
Q35119, Q35120	Same as Q35103	
Q35201, Q35202	Same as Q35101	
Q35203	Same as Q35103	
Q35204	Same as Q35104	
Q35205	Same as Q35105	
Q35206	Same as Q35104	
Q35207	Same as Q35105	
Q35208	Same as Q35108	
Q35209	Same as Q35104	
Q35210	Same as Q35104	
Q35211	Same as Q35103	
Q35212	Same as Q35104	
Q35213	Same as Q35105	
Q35214	Same as Q35104	
Q35215	Same as Q35105	
Q35216	Same as Q35116	
Q35217, Q35218	Same as Q35104	
Q35219, Q35220	Same as Q35103	
Q35301	Transistor, 2SC 2901	DTR135741
Q35302	Same as Q35301	
IC35101	IC., NJM4558D	DIC613031
IC35102	IC., UVC 3120	DIC641071
IC35103	IC., SN 74ALS374N	DIC192321
IC35201	Same as IC35101	
IC35202	Same as IC35102	
IC35203	Same as IC35103	
IC35301	IC., 74F153PC	DIC198141
IC35302	IC., MC 74HC393N	DIC443941
IC35303	Same as IC35302	
IC35304	IC., 74F00PC	DIC198031
IC35305	IC., 74F74PC	DIC198021
IC35306	IC., MC 74HC00N	DIC440011
IC35307	IC., HA 17012PB	DIC641901
IC35308	Same as IC35101	
IC35309	IC., LT 1016CH	DIC630941
IC35310	IC., MC 10H102L	DIC322201
IC35311	IC., 201RHT2507P	DZB990081
IC35312	IC., 201RHT5007P	DZB990071
IC35313	Same as IC35312	
IC35314	Same as IC35311	
J35101	Connector, M36M87-02	DCN034601
J35201	Same as J35101	
J35301	Connector, ZC-024	DCN032821
J35302	Connector, M36M87-05	DCN034631
J35303	Connector, M36M87-04	DCN034621
J35304, J35305	Same as J35101	
P35101	Connector, M36-02-30-114P	DCN034851
P35201	Same as P35101	
P35301		
P35302	Connector, M36-05-30-114P	DCN034881
P35303	Connector, M36-04-30-114P	DCN034871
P35304	Same as P35101	
P35305	Same as P35101	
T35101	Coil, K5 T3-6-1, 5 (8Tx4Tx4T)	DCL152021
T35102	Coil, K5 T5-10-2.5 (8Tx8T)	DCL152031
T35201	Same as T35101	
T35202	Same as T35102	
FL35301	Flat cable, SMCD-24X100-BDX10(2.7) P1.25	KHB087811
DL3501	Delay line, AT-02	DZB990281

DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C36101	Cap., 100μ, ±20%, 16V, Elect.	DCE225351
C36102	Cap., 0.01μ, −20 ~ +80%, 50V, Cer.	DCC139501
C36103, C36104	Same as C36102	
C36105	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
C36106 to C36109	Same as C36102	
C36111	Cap., 100p, ±5%, 50V, Cer.	DCC239051
C36201	Same as C36101	
C36202 to C36204	Same as C36102	
C36205	Same as C36105	
C36206 to C36209	Same as C36102	
C36211	Same as C36111	
C36301	Cap., 560, ±5%, 50V, Cer.	DCC239251
C36302	Cap., 150, ±5%, 50V, Cer.	DCC239021
C36303	Cap., 220, ±5%, 50V, Cer.	DCC239121
C36304 to C36306	Same as C36102	
C36311	Same as C36101	
C36312	Same as C36102	
C36313	Same as C36101	
C36314	Same as C36102	
C36315	Same as C36101	
C36316	Same as C36102	
C36317	Same as C36101	
C36318	Same as C36102	
R36101	Res., 3.0K, ±1%, 1/4W, Metal	DRE137991
R36102	Res., 2.0K, ±1%, 1/4W, Metal	DRE137951
R36103	Res., 33, ±1%, 1/4W, Metal	DRE137521
R36104	Same as R36103	
R36105	Res., 1.0K, ±1%, 1/4W, Metal	DRE137881
R36106	Res., 200, ±1%, 1/4W, Metal	DRE137711
R36110	Res., 100, ±1%, 1/4W, Metal	DRE137641
R36201	Same as R36101	
R36202	Same as R36102	
R36203, R36204	Same as R36103	
R36205	Same as R36105	
R36206	Same as R36106	
R36210	Same as R36110	
R36301	Res., 8.2K, ±1%, 1/2W, Metal	DRE141051
R36302	Res., 2.7K, ±1%, 1/4W, Metal	DRE137981
R36303	Res., 330, ±1%, 1/4W, Metal	DRE137761
R36304	Res., 1.3K, ±1%, 1/4W, Metal	DRE137911
R36305	Res., 1.2K, ±1%, 1/4W, Metal	DRE137901
R36306	Same as R36102	
R36307	Res., 130, ±1%, 1/4W, Metal	DRE137671
R36310	Res., 4.7K, ±1%, 1/4W, Metal	DRE138041
RA36101	Resistors array, 10K, ±5%, 1/8W, Metal	DFB015631
RA36201	Same as RA36101	
D36101	Diode, 1SS 120 TA21R	DDD019071
D36102	Same as D3501	
D36201, D36202	Same as D36101	
D36301, D36302	Same as D36101	
Q36101	Transistor, 2SC 1815GR TPER1	DTR139011
Q36201	Same as Q36101	
Q36301	Transistor, 2SC 2901	DTR135741
Q36302	Same as Q36101	
Q36303	Transistor, DTC 114-A	DTR190941
Q36304	Same as Q36101	
IC36101	IC., MP 7684	DIC641021
IC36102	IC., NJM 4558D	DIC613031
IC36103	IC., SN 74LS374N	DIC142941
IC36201	Same as IC36101	
IC36202	Same as IC36102	
IC36203	Same as IC36103	
IC36301	IC., 74F 153PC	DIC198141
IC36302	IC., 74F 00PC	DIC198031
IC36303	IC., 201RHT5007D	DZB990071
J36101	Connector, M31M87-07	DCN034501
J36201	Same as J36101	
J36301	Connector, ZC-024	DCN032821
J36302	Same as J36101	
J36303	Connector, M36M87-04	DCN034621
J36304	Same as J36101	
J36305	Connector, BNC234	DCN040731
P36101	Connector, M36-02-30-114P	DCN034851

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
P36201	Same as P36101	
P36301		
P36302	Same as P36101	
P36303	Connector, M36-04-30-114P	DCN034871
P36304	Same as P36101	
FL36301	Flat cable SMCD-24X100-BDX10(2.7) P1.25	KHB087811

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C4117	Cap., 0.01μ, 30%, 16V, Cer.	DCC929031
C4121	Same as C0417	
C4125	Same as C0417	
C4128 to C4131	Same as C0417	
C4138 to C4150	Same as C0417	
C4155, C4156	Same as C0417	
C4160	Same as C0417	
C4164	Same as C0417	
C4168 to C4173	Same as C0417	
C4176	Same as C0417	
C4180	Same as C0417	
C4184 to C4187	Same as C0417	
C4101	Cap., 150p, ±5%, 50V, Cer.	DCC239221
C4102	Cap., 30p, ±5%, 50V, Cer.	DCC239341
C4103	Cap., 330p, ±5%, 50V, Cer.	DCC239181
R4101	Res., 47K, ±1%, 1/4W, Metal	DRE138281
R4102	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R4103	Res., 200, ±1%, 1/4W, Metal	DRE137711
IC411A	IC., 201RHT5007	DZB990071
IC411H	IC., 201RHT2507P	DZB990081
IC411K	IC., 74F32PC	DIC198091
IC413D	IC., 74F02PC	DIC198041
IC413F	Same as IC411A	
IC414B	IC., 74F74PC	DIC198021
IC414C	IC., SN 74LS221N	DIC142071
IC414D	Same as IC411H	
IC414E	IC., 74F244PC	DIC198181
IC414F	Same as IC411K	
IC414H	Same as IC411A	
IC415B	IC., 74F20PC	DIC198081
IC415C	IC., 74F08PC	DIC198051
IC415D	Same as IC414B	
IC415E	IC., 74F00PC	DIC198031
IC415F	IC., 74F04PC	DIC198001
IC415H	Same as IC415E	
IC415J	Same as IC414B	
IC416B	Same as IC411H	
IC416C	Same as IC415C	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
IC416D	IC., SN 74LS04N	DIC140051
IC416E	Same as IC411H	
IC416F	Same as IC414B	
IC416H	Same as IC414B	
IC417B	Same as IC411H	
IC417D	IC., MB 670102	DIC492701
IC417F	Same as IC415C	
IC417H	Same as IC415F	
IC418B	IC., SN 74LS244N	DIC142141
IC418C to IC418D	Same as IC418B	
IC418E	IC., 74F 374PC	DIC198231
IC418F	Same as IC411K	
IC418H	Same as IC411K	
IC419B	Same as IC418E	
IC419C	Same as 41IC8E	
41IC9D	Same as IC418B	
IC419E	Same as IC418E	
IC419F	IC., 74F64PC	DIC198011
IC419H	Same as IC411K	
IC4110F	Same as IC419F	
IC4110H	Same as IC419F	
IC4111B	IC., HM 6788P-25	DIC516211
IC4111C to IC4111E	Same as IC4111B	
IC4111F	IC., CK2605	DIC546221
IC4111H	Same as IC419F	
J4101	Connector, 68905-001	DCN992801
J4103	Same as J4101	
J4105	Same as J4101	
J4101	Connector, ZC-124	DCN032521
P4101	Connector Header, 68908-012	DCN993621
P4103	Same as P4101	
P4105	Same as P4101	
X4102	Crystal, TD308A 40MHZ	DHF010581

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C5127	Cap., 10p, ±0.5%, 50V, Cer.	DCC239041
C5135	Cap., 0.01μ, ±30%, 16V, Cer.	DCC929031
C5136, C5137	Same as C5135	
C5151 to C5154	Same as C5135	
C5157 to C5159	Same as C5135	
C5161 to C5163	Same as C5135	
C5165 to C5167	Same as C5135	
C5183	Same as C5135	
C5101, C5102	Same as C5135	
C5103	Cap., 22μ, ±20%, 50V, Elect. (DS-6612)	DCE249361
C5103	Cap., 4.7μ, ±20%, 50V, Elect. (DS-6411)	DCE249341
C5104	Cap., 0.01μ, +80 ~ −20%, 50V, Cer.	DCC133571
C5105	Same as C5104	
C5125	Cap., 0.22μ, −20 ~ +80%, 50V, Cer.	DCC137171
C5126	Same as C5127	
C5128	Cap., 22μ, ±20%, 25V, Elect.	DCE225321
R5101	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R5102	Same as R5101	
R5103	Res., 3.9K, ±1%, 1/4W, Metal	DRE138021
R5104	Same as R5101	
R5105	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
RA5101	Resistors array, 10K, ±5%, 1/6W, Metal	DFB015561
RA5102	Resistors array, 10K, ±5%, 1/8W, Metal	DFB015631
IC514J	IC., 74F139PC	DIC198401
IC514M	IC., MC 74HC32N	DIC440331
IC514N	Same as IC514M	
IN514P	IC., MC 74HC04N	DIC440051
IC516J	IC., MC 74HC138N	DIC441391
IC516L	IC., SRAM 256K (DS-6612 only)	DIC515891
IC516M	Same as IC516L	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
IC516N	IC., MBM 27C512-25CZ	DIC525501
IC517J	IC., MC 74HC244N	DIC442451
IC517L	IC., TC74HCT245P/HD74HCT245P	DIC492461
IC517M	Same as IC517J	
IC518J	Same as IC517J	
IC518L	Same as IC517J	
IC518M	Same as IC517J	
IC518N	IC., HD 64B180ROP	DIC552431
IC519J	IC., MC 74HC08N	DIC440091
IC519K	Same as IC514M	
IC519L	IC., MC 74HC74N	DIC440751
IC519M	IC., MB 3771P-G	DIC690311
SW5101	Switch, KHH10906	DSW018481
J5101	Connector, ZC-140	DCN032801
J5102	Same as J5101	
P5102	Connector, M33-07-30-114P	DCN034691
FL5101	Flat cable SMCD-40X50-ADX10(2.7)P1.25	KHB087711
X5101	Crystal, NR-18 12,288 MHZ	DHF010111

DS-6612/DS-6411

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
C5201	Cap., 0.01μ, ±30%, 16V, Cer.	DCC929031
C5203	Same as C5201	
C5204 to C5207	Same as C5201	
C5209 to C5211	Same as C5201	
C5215, C5216	Same as C5201	
C5234	Same as C5201	
C5110	Cap., 0.22μ, −20 ~ +80%, 50V, Cer.	DCC137171
C5211	Cap., 0.15μ, ±10%, 50V, Film	DCF121461
R5201	Res., 10K, ±1%, 1/4W, Metal	DRE138121
R5202	Res., 1.0M, ±1%, 1/4W, Metal	DRE138601
R5203	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R5204	Same as R5203	
RA5201	Resistors array 680, ±5%, 1/5W, Metal	DFB018341
RA5202	Resistors array 680, ±5%, 1/4W, Metal	DFB018331
IC521B	IC., TC74HC32P/HD74HC32P	DIC450331
IC521D	IC., MC 74HC74N	DIC440751
IC521E	IC., MC 74HC21N	DIC440221
IC522A	Same as IC521E	
IC522B	IC., TC74HC138P/HD74HC138P	DIC451391
IC522C	IC., TC 74HC123P	DIC492291
IC522D	Same as IC521B	
IC522F	IC., MC 74HC573N	DIC445741
IC522H	IC., MC 74HC574N	
IC522J	Same as IC522H	DIC445751
IC523B	Same as IC521B	
IC523C	IC., MC 74HC08N	DIC440091
IC524L	IC., MC 74HC00N	DIC440011

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C5302	Cap., 0.01μ, ±30%, 16V, Cer.	DCC929031
C5308	Same as C5302	
C5312 to C5314	Same as C5302	
C5318 to C5320	Same as C5302	
C5322 to C5324	Same as C5302	
C5333	Same as C5302	
C5335	Same as C5302	
C5301	Cap., 0.22μ, ±20%, 50V, Cer.	DCE245041
C5302	Cap., 100p, ±5%, 50V, Cer.	DCC239051
C5310	Same as C5302	
R5301	Res., 5.1K, ±5%, 1/4W, Carbon	DRD137811
R5302	Same as R5301	
R5303	Res., 7.5K, ±5%, 1/4W, Carbon	DRD137851
R5304	Res., 15K, ±5%, 1/4W, Carbon	DRD137921
R5305	Res., 100K, ±5%, 1/4W, Carbon	DRD138121
R5306	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R5307	Same as R5303	
R5308	Res., 1.0K, ±5%, 1/4W, Carbon	DRD137641
R5309	Same as R5308	
R5310	Same as R5303	
R5311	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R5312, R5313	Same as R5303	
R5314	Same as R5311	
RA5301	Resistors array, 10K, ±5%, 1/8W, Metal	DFB015631
RA5302	Resistors array, 10K, ±5%, 1/6W, Metal	DFB015561
IC531F	IC., MC 74HC74N	DIC440751
IC531C	Same as IC533K	
IC532E	IC., MC 74HC123AN	DIC441241
IC532K	IC., MC 74HC367N	DIC443681
IC532L	IC., TC 74HCT245P/HD74HCT245P	DIC492461
IC532N	IC., LM 393N	DIC630831
IC533A	Same as IC532K	
IC533E	Same as IC531F	
IC533H	IC., MC 74HC08N	DIC440091
IC533J	IC., MC 74HC32N	DIC440331
IC533K	IC., MC 74HC04N	DIC440051
IC533L	IC., MC 74HC138N	DIC441391
IC533M	IC., μ-PD 8279C-5	DIC555291
IC533N	IC., μ-PD 4701AC	DIC555991
J5304	Connector header, 68907-003	
J5301	Connector, ZC-020	DCN032701
J5302	Connector, ZC-116	DCN032761
J5303	Connector, M36M87-04	DCN034621
J5304	Same as J5303	DCN992841
P5303	Connector, M36-04-30-114P	DCN034871

CPU-4 [54]

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
C5432	Cap., 0.01μ, ±30%, 16V, Cer.	DCC929031
C5474, C5475	Same as C5432	
C5481, C5482	Same as C5432	
R5402	Res., 10K, ±5%, 1/4W, Carbon	DRD137881
R5401, R5402	Same as R5402	
RA5401	Resistors array, 10K, ±5%, 1/4W, Metal	DFB015541
IC5410K	IC., MC 74HC32N	DIC440331
IC5410L	IC., TC74HC138P/HD74HC138P	DIC451391
IC5410M	IC., MC 74HC74N	DIC440751
IC5410N	IC., MC 74HC20N	DIC440211
IC5411J	IC., S-2210R	DIC516071
IC5411L	IC., MC 74HC245P/HD74HC245P	DIC452461
IC5411N	IC., MC 74HC244N	DIC442451
J5401	IC Socket, IC30-1603-G4	DSK045611
J5402	Same as J5401	

KEY BOARD [55]

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DS-6612/DS-6411		
D5501	ELD, TLG206	DDD071121
D5502	Same as D5501	
D5503	Diode, 1SS 120 TA21R	DDD019071
D5504	Same as D5503	
SW5501	Switch, KEC11015	DSW025471
SW5502 to SW5504	Same as SW5501	
SW5505	Switch, KEC10001	DSW018241
SW5506	Same as SW5505	
SW5507 to SW5509	Same as SW5501	
SW5510	Same as SW5505	
SW5512	Same as SW5501	
J5501	Connector, ZC-020	DCN032701
FL5501	SMCD-20X150-ADX10(2.7)P1.25	KHB091511
RE5301	Rotary encode, RES 20-50-200	DME990251

MP MASTER
MA32269